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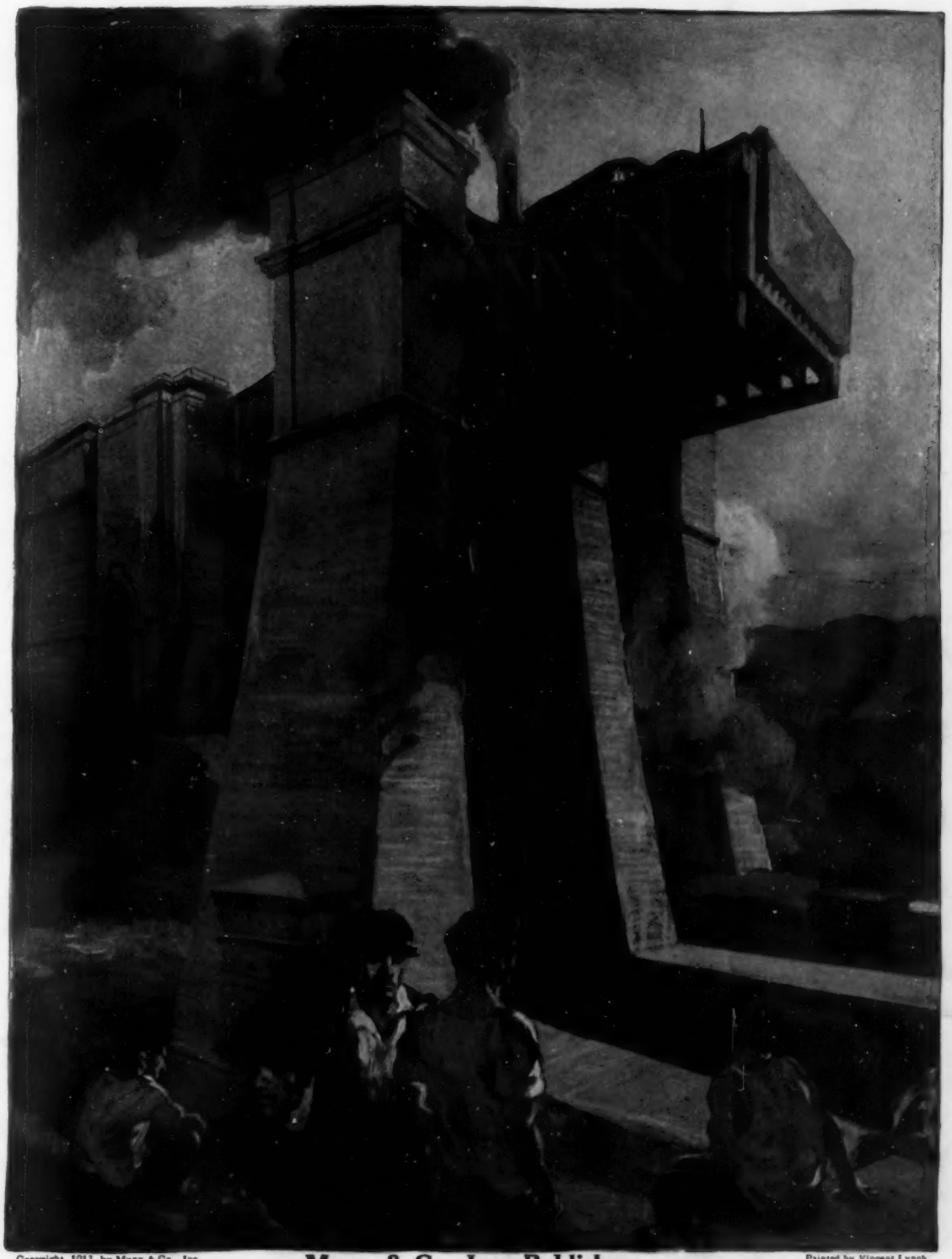
SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION



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Vol. CIX. No. 10
September 6, 1913

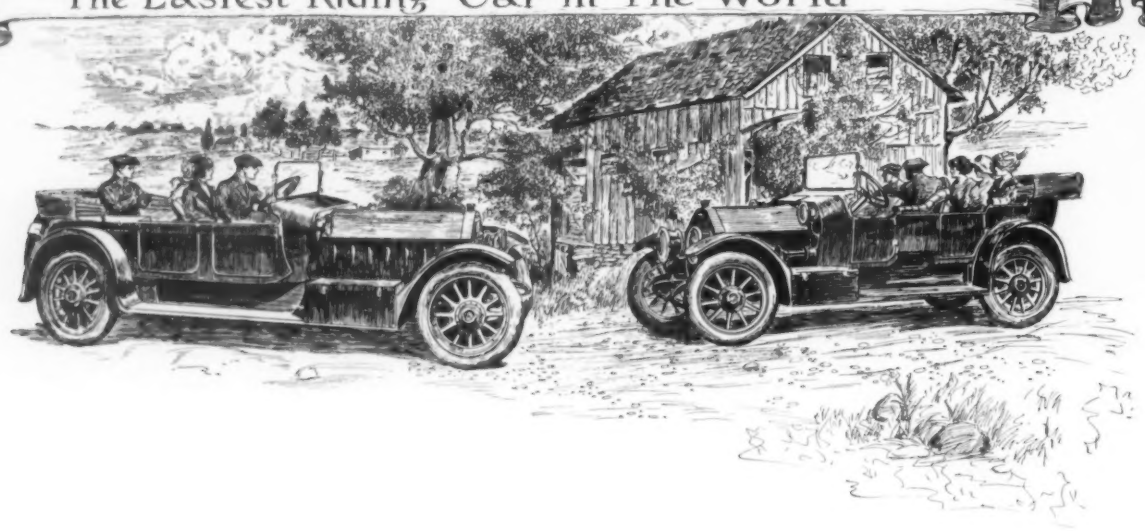
Munn & Co., Inc., Publishers
New York, N. Y.

Painted by Vincent Lynch

Price
15 Cents

MARMON

"The Easiest Riding Car In The World"



REAL worth is measured by but one standard—Time. Weighed in the crucible of Time, the Marmon has come to represent the greatest of automobile values. Consider the car you buy not only by the demonstration in all the newness of its beauty—but by the comfort, capability and service of the car of four, five or six seasons' use. Dividing dollars of investment by either days or miles of satisfactory service will point out to you the true wisdom of buying the best—of owning a Marmon.

Note—If you would "know the maker as well as the car"—we have recently issued a folder giving the history of Nordyke & Marmon Company from its beginning, over sixty years ago, to to-day, illustrating the development of the Marmon car. The old frame building shown in the sketch above is the first Nordyke & Marmon factory, built in 1851—the present factory is shown below. The constant growth of this great institution is proof of the soundness of its policy—"the best that can be produced at a fair price, for the greatest service to the purchaser." Every Marmon car is better for this unwavering standard.

The Marmon "Thirty-Two"

Price, $3,000. Four-cylinder, 32-40 h. p., 120-inch wheel base, body types and equipment to meet every requirement. A rational, logical car for touring and city use. Years of satisfactory service have proved its economy in tires, fuel and upkeep—plus smooth, delightful operation and durability.

The Marmon "Forty-Eight"

Price, $5,000. Six-cylinder, 48-80 h. p., 145-inch wheel base with short turning ability, eliminating the old objections to long wheel base. Body types and equipment to meet every requirement. The only big car with small car advantages. Wonderful riding qualities and surpassing power and flexibility. A car developed by years of exacting tests.

Nordyke & Marmon Co.

INDIANAPOLIS (Established - 1851) INDIANA

Sixty Years of Successful Manufacturing

Cadillac
Standard of the World

The way in which the world is receiving the 1914 Cadillac, the wonderful manner in which it is performing, presages an unprecedented Cadillac year

There never have been enough Cadillacs—there surely will not be enough of this new 1914 model.

In the year closing June 22nd, the Cadillac Company manufactured and distributed 15,007 cars.

Several thousand buyers, anxious to own Cadillacs, were compelled to be content with other cars.

It was the story of the previous year all over again, in spite of increased production.

And the story of the year before—and the year before that.

Each season the same thing has happened—several thousand more Cadillacs could have been distributed had we been able to produce them.

Intending buyers, disappointed in securing Cadillacs, have been numerous enough to constitute almost the entire clintele of some other cars.

For 1914 we plan to manufacture 18,000 cars.

It is perfectly obvious that Cadillac history is not only repeating, but surpassing itself.

Reports from all parts of the country make one thing perfectly plain, to-wit:

That the accustomed Cadillac demand has been intensified into downright eagerness.

This is due to evolutionary developments in the new car.

Most potent among them is the marvelous influence of the Two Speed Direct Drive Axle.

Every one who rides in the new Cadillac recognizes immediately that its well known smoothness has been supplemented by an entirely new riding quality.

This is demonstrated at once, even to the inexperienced motorist.

Going even at high speed, the passengers discover that motoring in this new Cadillac *has lost its sense of strain.*

Unless the eye is on the speedometer, one is apt to guess that the car is going at about half its actual rate of travel.

Mentally and physically, driver and passengers unconsciously relax, revelling in the delight of a new and luxurious sensation, oblivious to the almost watch-like mechanism.

And on the heels of this delightful discovery, come others equally pleasant.

The owner finds that this Two Speed Direct Drive principle influences almost every Cadillac function which contributes to ease, efficiency and economy.

It not only brings into being a new degree of luxury, but accomplishes an abatement of operating cost.

The slower engine speed results in greater power generated from a given amount of fuel.

The slower moving parts means less friction.

Both of these mean lower fuel consumption.

But above all else is the contrast between the Cadillac and the average car with the ordinary gear ratio.

The trembling oscillation of the latter is transformed in the Cadillac into a straight-ahead, steady motion which reduces vibration almost to the vanishing point.

A simple electric switch changes the gear from low to high, and like magic, there is added to any given speed of the engine an increase of 42 per cent in the speed of the car.

Now—recall to your mind the high repute in which the Cadillac is held.

Remember its record for workmanship almost miraculously fine; for strict standardization of its parts; for alignment of its units.

Remember its reputation for staunchness, for dependability, for long life, and for the supreme satisfaction and service which it renders to its users.

Remember its reputation for economy of operation and maintenance.

Remember the stability and the ideals of the organization behind it.

Consider all these things stimulating the rivalry for early deliveries.

And then try to conceive the effect of this new revelation of Cadillac progress added to all the others.

You will realize, then, that we are acting in your interest when we advise you to book your order now, even if you do not wish your new Cadillac delivered for several months.

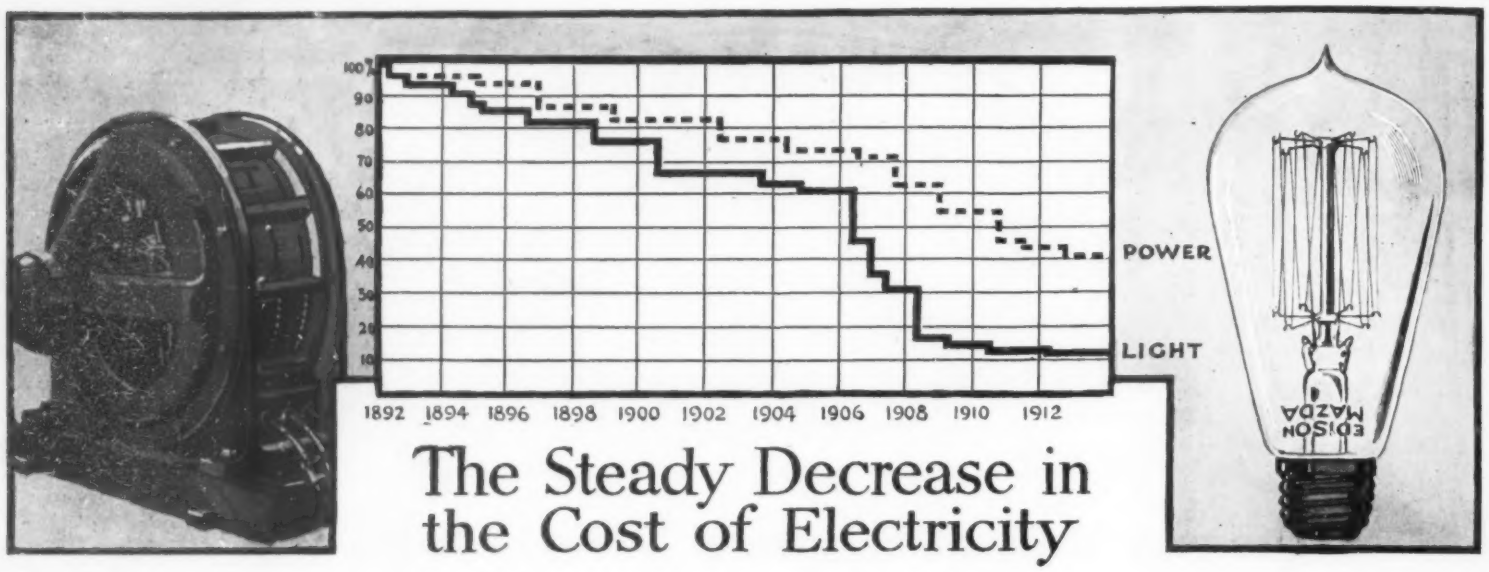
STYLES AND PRICES

Standard Touring Car, five passenger $1975.00

Seven passenger car $2075.00	Roadster, two passenger $1975.00	Inside drive Limousine, five passenger . . $2800.00
Phaeton, four passenger 1975.00	Landaulet Coupe, three passenger . 2500.00	Standard Limousine, seven passenger . . 3250.00

All prices are F. O. B. Detroit, including top, windshield, demountable rims and full equipment

Cadillac Motor Car Co. Detroit, Mich.



The Steady Decrease in the Cost of Electricity

"They say you can prove anything with statistics," said the manager of a big Indiana manufacturing plant to the Board of Directors, "but when the statistics are on your own books you can believe them. And the figures show that since we installed electricity, seven years ago, electricity is the one item of costs that has steadily gone down."

The manager was arguing for an extended application of electricity in the plant—and he won his point.

This manager's declaration as to power cost was fully in accord with the remark of Thomas A. Edison in the matter of lighting. "Electric light," said Mr. Edison, "is the only thing I know of that has become any cheaper in the last ten years."

Why has electricity declined in cost when indisputable figures and the common experience of men show that "the cost of living" has been steadily rising?

It is plain that many of the commodities whose increase in cost is chiefly responsible for the increased cost of living enter into the production of electric light also—coal, labor, and copper for example. From 1902 to 1907 coal increased 6½ percent. Within the same time labor advanced 8½ percent. The cost of copper increased about 35 percent. Yet the cost of electricity went *down* as steadily as the cost of living went *up*.

Mechanical factors have had much to do with this reduction. In the first place the more advantageous placing of electric plants beside water falls or coal mines. Then larger plants and great improvements in transmission systems have played a part. Improved generating systems, as with the Curtis Turbine Engine, and the cheapening of installations by new inventions, have added in an important way to this progress in economy of use. Invention and price as factors appear in the case of light, for instance, when the sharp decline in cost between 1892 and 1898 was due largely to the reduction in the price of carbon lamps. New types of lamps effected a further reduction between 1899 and 1902, and the perfecting of the Tungsten and later the Edison Mazda lamp, which uses only one third of the current required for the old-style lamps in common use, has again lowered the figures since 1908.

A fact of specific and striking interest is that all classes of users of electric light and power have not only shared in the reduction but have *helped to bring it about*.

This has happened under the natural conditions of *extended use*. The wider use of electric power and light has enabled distributing plants to sell current for a greater number of hours in the twenty-four and in this way to reduce rates based on the twenty-four hour maintenance of the plant.

Thus in Chicago one dollar now almost buys eight times as much electric light as it did in 1886, more than twice as much as in 1909, just four years ago. Another illustration of progressive conditions as they are shown in large distributing centers is Boston's reduction of over sixty percent. in a single decade.

The results of methods of *use* as well as method of *supply*—this is the story of the chart on this page.

And in all this growth of electricity from primitive experiment to world-wide usefulness, the General Electric Company has played a leading part. Just as electric lamps have been developed in the G-E factories for all uses from the lighting of automobiles to the lighting of factories—so numberless types and sizes of G-E motors are now available for driving all kinds of machines from dentists' drills to massive steel rolling mills.

To know how electricity may fit your particular business, consult your local power and lighting company, or any G-E dealer or agent in your vicinity. No matter how simple or how complex your problem may be, these agents have always at their command not only information of the latest developments, but also the co-operation of any part of the G-E organization that may be most helpful to them and to you.

The Guarantee of Excellence on Goods Electrical

Trade Mark

GENERAL ELECTRIC COMPANY

Largest Electrical Manufacturer in the World

Atlanta, Ga.
Baltimore, Md.
Birmingham, Ala.
Boise, Idaho
Boston, Mass.
Buffalo, N. Y.
Butte, Mont.
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Charlotte, N. C.
Chattanooga, Tenn.
Chicago, Ill.
Cincinnati, Ohio
Cleveland, Ohio
Columbus, Ohio
Davenport, Iowa
Dayton, Ohio
Denver, Colo.
Detroit, Mich. (Offices of Agt.)
Elmira, N. Y.
Erie, Pa.
Hartford, Conn.
Indianapolis, Ind.
Jacksonville, Fla.
Joplin, Mo.
Kansas City, Mo.
Keokuk, Iowa
Knoxville, Tenn.
Los Angeles, Cal.
Louisville, Ky.
Madison, Wis.
Mattoon, Ill.
Memphis, Tenn.
Milwaukee, Wis.
Minneapolis, Minn.
Nashville, Tenn.
New Haven, Conn.
New Orleans, La.
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Omaha, Neb.
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Richmond, Va.
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San Francisco, Cal.
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Seattle, Wash.
Spokane, Wash.
Springfield, Mass.
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Toledo, Ohio.
Washington, D. C.
Youngstown, Ohio.

For Texas, Oklahoma and Arizona business refer to Southwest General Electric Company (formerly Hobson Electric Co.)—Dallas, El Paso, Houston and Oklahoma City.
For Canadian business refer to Canadian General Electric Company, Lt'd, Toronto, Ont.

4190

SIXTY-NINTH YEAR

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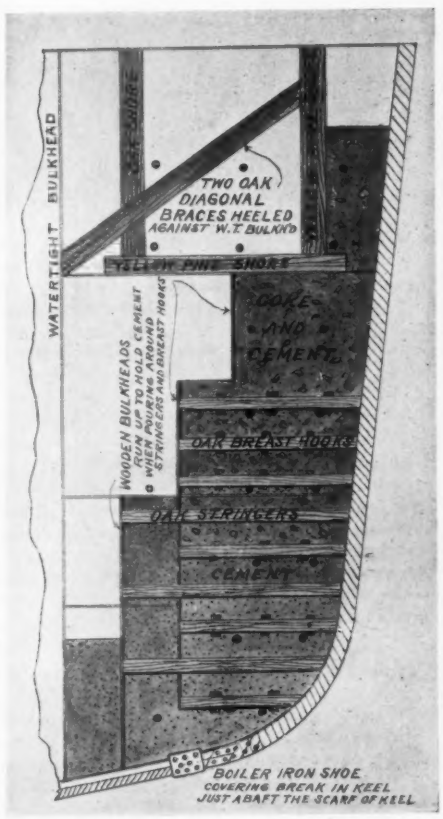
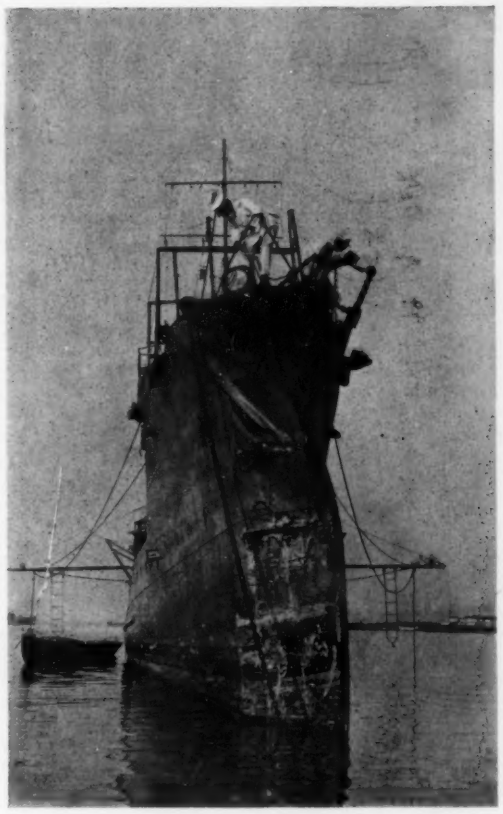
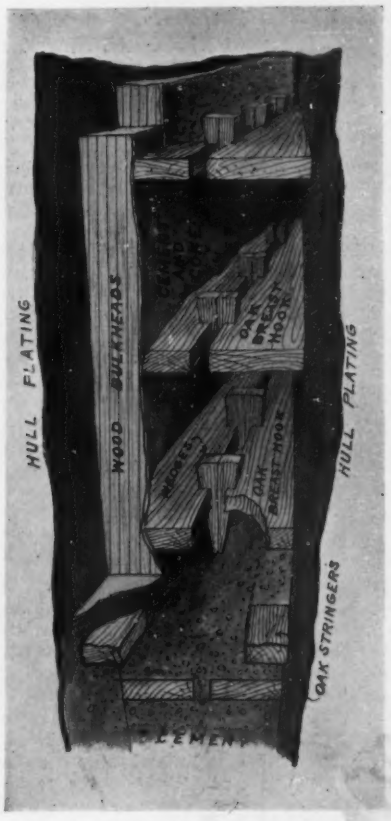

WATERTIGHT BULKHEAD
TWO OAK DIAGONAL BRACES HEELED AGAINST W.T. BULKHD
YELLOW PINE SHORE
COKE AND CEMENT
WOODEN BULKHEADS RUN UP TO HOLD CEMENT WHEN POURING AROUND STRINGERS AND BREAST HOOKS
OAK BREAST HOOKS
OAK STRINGERS
CEMENT
BOILER IRON SHOE COVERING BREAK IN KEEL JUST ABAFT THE SCARF OF KEEL

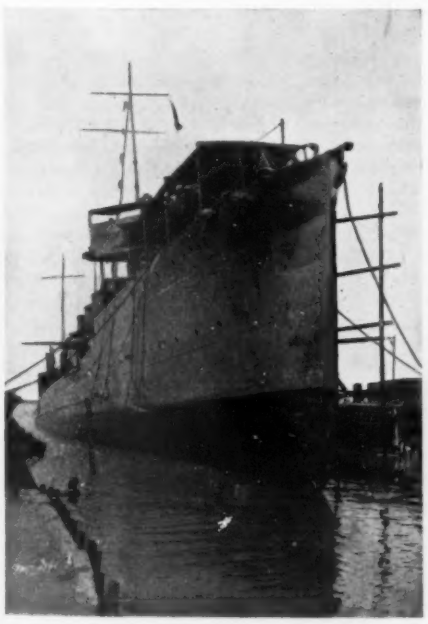
Vertical section through bow, showing emergency repairs to destroyer "Burrows."



Bow of "Burrows," twisted 85 degrees to port by collision.



Looking into bow, showing oak breasthooks and stringers and cement filling.



The job completed. Note new plating on upper half of bow.

The ship backing off, all repairs completed.

Starboard plating softened by torch and hauled back into position by tackles.

EMERGENCY REPAIRS BY BLUEJACKETS OF THE DESTROYER "BURROWS."—[See page 180.]

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Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Commercial and Military Value of the Intra-coastal Waterway

THE economics and military advantages to be gained by the construction of the system of intra-coastal waterways which is recommended to Congress by Brigadier General Bixby, the Chief of Engineers, U. S. A., are so many and valuable, that we believe Congress, after mature deliberation, will be convinced that the $30,000,000 necessary for constructing a 12-foot waterway from New York to Beaufort, North Carolina, should be appropriated.

As matters now stand, the coastwise traffic, whether by water or rail, is being carried either by ocean-going ships using the outside deep-sea route, or by railway systems which are approximately parallel to the coast-line. To justify the construction of an intra-coastal waterway, it must be shown that a certain portion—a sufficient portion—of this traffic can be carried as safely, more expeditiously, and at lesser cost by the proposed canal. The opponents of the canal claim that the carriage of freight can be done more economically under the present method by ocean-going steam and sail vessels and ocean-going barges under tow, and by the existing railways. As regards the question of safe transit, the statistics of the annual losses of life and of ships and their cargoes in the coastwise trade prove that they are enormous and show no signs of diminution. To reduce these losses, coastwise vessels are built more stoutly and at much larger cost than those which use interior water routes. Thus ocean-going vessels cost $75 per ton, vessels for use on the Great Lakes cost $45.50 per ton, and the Mississippi River tug with barges for 10,000 tons of freight, cost only $12 per ton. Furthermore, the expenses of deep-sea carriage are increased by the higher marine insurance, which is from 8 to 12 per cent per year for these ships as against an average of 4 per cent on vessels using inside routes. To this must be added the greater time occupied on an outside route, due to the longer course and to the delays due to wind and weather.

A review of these facts in the report of the Chief of Engineers, made in January, 1912, leads him to state that the advantages of navigation by interior over outside routes are such as, in general, to justify the opening of interior waterways, a conclusion with which we are in hearty agreement.

On the question of the relative economy and convenience of transportation by inland waterways and by approximately parallel railways, it should be carefully noted that any deductions, drawn from previous experience, in which inland waterborne commerce has declined where it has come into competition with railways, are liable to be very misleading. It has been the policy of the railway to make discriminating rates, cheapening the service by rail at points where competition with water routes was possible, and making interior points which were not favored with water routes pay the cost of such competition. The work of the Interstate Commerce Commission and the pressure of an enlightened public opinion are removing the burden of discrimination; and it is certain that if the Federal Government constructs the proposed intra-coastal waterway, it will see to it that the new route is effectively protected against any such burdensome rate discrimination.

The report of the Army Engineers draws attention to the facts that it has been a policy of the railway companies to obtain possession, as far as possible, of all available wharf space in terminal cities, partly with a view to preventing competition; that the railways have thrown obstacles in the way of dividing a long-distance haul between rail and water, so as to make an all-rail carriage most advantageous. This has been done by placing difficulties in the way of tranfer between rail and water, by refusing to honor through bills of lading over a fixed rail-and-water route; by making charges for short hauls by rail and distribution from water terminals prohibitively high. If the full benefits of improved waterways are to be obtained, both the nation and the States must take such action as will insure fair co-operation between the companies operating by rail and by water.

Nor must it be assumed that the opening of the intra-coastal waterway will operate to the disadvantage of the railways. Experience gives reason to expect that there will be a division of the freight based upon its character, the cheaper freight carried in bulk going to the water route, and the expensive freight calling for rapid carriage gravitating to the railways.

The results of rail and water competition in Europe, where the canal and navigable river mileage is enormous, shows that the one system is not inimical to the interests of the other. Thus, in Germany we find that in 1875, the traffic over 26,500 kilometers of railway amounted to 10,900,000,000 kilometer-tons; while the traffic over 10,000 kilometers of waterway amounted to 2,900,000,000 kilometer-tons. Thirty years later, in 1905, the traffic over 54,400 kilometers of railways was 44,600,000,000 kilometer-tons, and the traffic over the 10,000 kilometers of waterways was 15,000,000,000 kilometer tons; from which it is evident that the kilometer and mile tonnage increase by rail was four times and that by water five times.

On the question of the military value of the intra-coastal waterway, the report of the Army Engineers points to the well-established principle that for the defense of a frontier threatened by an attack from without at some unknown point, the forces for the defense should be concentrated within the frontier line, at points from which they can move rapidly and safely to the actual point of attack when developed. The proposed waterway between New York and Norfolk is considered by the Army Engineers to form a most desirable line for such movements of troops, lying as it does for its entire distance under the shelter of fortifications built or planned for the defense of the coast. Furthermore, it is shown that the movement of troops by sheltered water transportation has many advantages over transportation by rail. Thus, larger administrative units will be united in a single carrier; there are diminished chances of delay due to breakdown of one of the transporting units; there is a smaller number of units required; and there is a greater freedom from ordinary delays of transit. For the transportation of a division of troops there would be required, by rail, 958 passenger and freight cars. To move the same division of troops by water would require the services of only 22 ships of the size of the "Momus" of the Southern Pacific Company, which has a 16-foot draught.

For naval purposes, the intra-coastal waterway presents the advantage of an additional and protected entrance for each of the ports from New York to Norfolk included—an advantage, says the report, which would make impossible an effective blockade of any one of those ports.

State vs. National Control of Public Forests

IT is well understood by those who closely follow the course of legislation in Congress that laws are occasionally placed on the statute books which, although they carry the appearance of being wise and beneficial, are in reality merely the outer cloak within which is concealed a positive menace to the public good. Of such a character, we do not hesitate to say, is the quiet but influential agitation which is now at work in favor of transferring our public forests from national to State control. The arguments in favor of this transfer are plausible, but specious—a fact which is well understood by the friends of forestation, who are straining themselves to the utmost to prevent the passage of an act which would prove to be one of the most potent agencies in exploiting by private interests what is left to the public of our national forests.

Although the issue is presented as one of State versus national control, it should be understood that the ultimate if not the present object of this movement is the substitution of private for public ownership. The surest protection against private exploitation is to maintain the control of our forests in the hands of the Federal Government; for it is evident that the conspiracy of an individual or of a collective body of men for the control of timber land would be more likely of success, if it were carried on in a State Legislature than in the halls of Congress itself.

The argument against State control is well stated in a recent pamphlet issued by the Oregon State Conservation Commission, and the reasons set forth coming from a State a large area of which is covered by forest land has a special emphasis. The Commission starts out by laying down the broad proposition that the National forests are the property of the nation and it argues that, if the nation is called upon to give this property outright to the State, then the burden is on the State to show how this great trust is to be administered so that those for whom it is granted will be better or even as well protected than they are now in their rights in and to it. Judged from a national standpoint, public forests do something more than merely furnish lumber and other timber products. They have other functions and uses which extend far beyond State lines and involve the welfare of many people exterior of the State, since they cover and protect the headwaters of streams used for navigation, irrigation and power, and to some extent minimize disastrous floods, the effects of which are not bounded by State lines. They retard soil erosion and thus have a beneficial effect which may be felt for hundreds and even indirectly for thousands of miles from the region covered by the forests themselves.

At present these national forests are under control of the Federal Government and the cost of their protection, about $4,000,000 a year, is paid from the national Treasury. In the State of Oregon alone there is expended in this work about $480,000 a year, an amount which is approximately one sixth as great as the State's total expenditures for all Governmental purposes. To this must be added the sums expended in actual fire fighting, which, in destructive seasons such as 1910 and 1911, amounted to from $75,000 to $112,000 additional. Now the State of Oregon has recognized the value of this great asset and the consequent obligation imposed, and it has worked in the closest co-operation with Federal agencies and private owners. The people of Oregon take the enlightened view that the State, to-day, is in a better position than if it owned the forests. As matters now stand the protection of the forests is paid for by the Federal Government and the State receives 35 per cent of the gross revenue. Moreover, the experimental work, studies as to use of timber, etc., from which the State receives the full benefit, are carried on by the Government. It is estimated that whenever a tree is felled and transformed into lumber, 80 per cent of the receipts are left in the hands of labor and those furnishing the supplies. "It is to be assumed," the Commission asks, "that the State management will be more efficient, less expensive and more satisfactory than that of the Forest Service?"

New York the Leading Port of the World

IT will be a matter of surprise, perhaps, and certainly of some pleasure, to the citizens of New York, to learn that the very latest estimates of the value of the exports and imports of the ten leading ports of the world show that New York now stands at the head of the list, with an advantage of nearly two hundred million dollars over London. Our contemporary, the *Marine Review*, reminds us that New York's total of exports and imports, now valued at $1,973,981,693 is over five times the amount of commerce what was carried on by the entire country half a century ago.

As to the future, there is one dominant factor, the Panama Canal, which is bound to strengthen the lead now secured by this port; for the canal will bring New York 1,600 miles nearer to Yokohama than is Liverpool; 2,500 miles nearer Sydney; 4,000 miles nearer Wellington, New Zealand, and 2,574 miles nearer Valparaiso. Bremen and Hamburg being some 500 miles further removed from the canal than Liverpool, it is evident that the new conditions—the general re-arrangement of trade routes—will tend to strengthen the position of this port in its supremacy over its nearest competitor. Expressed in round millions, the returns in value for the other leading ports are: London, 1,792 millions; Hamburg, 1,674 millions,; Liverpool, 1,637 millions; Antwerp, 1,121 millions; Marseilles, 678 millions; Havre, 531 millions; Bremen, 501 millions; Buenos Ayres, 479 millions; and Calcutta, 410 millions.

The Solar Constant.—Messrs. C. G. Abbot, F. E. Fowle and L. B. Aldrich have issued in *Astronomische Nachrichten* an advance statement of some highly important conclusions concerning the solar constant of radiation that will be published in an amplified form in the forthcoming third volume of the Annals of the Astrophysical Observatory of the Smithsonian Institution. On the basis of about 700 determinations of this constant made in various parts of the world and at various altitudes since 1902, it appears that (1) the mean value of the solar constant for the epoch 1905 to 1912 is 1.929 calories per square centimeter per minute; (2) an increase of 0.07 calory per square centimeter per minute accompanies an increase of 100 sunspot numbers (Wolfer); (3) irregular variations frequently exceeding 0.07 calory per square centimeter per minute occur within intervals of 10 days; (4) these variations are believed to be caused within the sun, and not by interposing meteoric or other matter.

Engineering

The Longest Reinforced-Concrete Arch.—What will be the longest arch in reinforced-concrete is now being built at Langwiez, Switzerland, on the Chur-Arosa Railway. The arch will have 160 feet rise and a clear length between abutments of 330 feet. This will be the largest structure of its kind in existence, being about two feet longer and 130 feet higher than the Risorgimento Arch over the Tiber at Rome, Italy.

Test of Canal Gates at Miraflores.—On August 25th water was turned into the Miraflores locks to test the watertightness of the gates, which proved to be quite satisfactory. By the time this reaches our readers the last of the earth dykes holding out the waters of the Pacific will be removed, and the tidal waters will extend through the canal to Miraflores. This section of the canal will then be in the completed condition, with the exception of a little finishing up by the dredges.

Economy of Storage Battery Railroad Cars.—The Prussian State Railways, after an experience of many years in the use of storage-battery cars on their system, have found that, without making any radical changes in the standard railroad cars, storage-battery propulsion may be applied successfully in respect of both operation and economy. According to the *El ctrical Review*, the cost of operating the 200 cars of this type on these railways works out at only 1.75 cents per horse-power per hour.

To Build Up the Floating Navy.—We are heartily in sympathy with Secretary Daniels in his determination to bend every effort toward bringing up our navy afloat to its proper standard of strength. He is reported as stating that he will recommend to Congress that appropriations be devoted more completely than ever to the construction of battleship destroyers, submarine tenders and colliers. In order to compensate for the one battleship programme of the two preceding years the next appropriation should be for four battleships.

Memorial to the Late Sir William White.—We commend to the attention of those who are interested in naval and nautical matters the fact that a meeting was recently held at the Institution of Naval Architects, London, to establish a memorial to the late Sir William White. It was resolved to form a committee representing the naval and merchant services, as well as the engineering profession, in order to carry out the object in view. Promises of financial support will be received by the secretary of the Institution of Naval Architects, 5 Adelphi Terrace, London.

A Foettinger Reduction-Gear Economy.—The Foettinger reduction-gear may be broadly described as a circulating pump discharging into a water wheel, with regulating vanes to determine the relative speed of rotation of the power and the driven shafts. In the celebrated tests made recently at the Vulcan Works, Hamburg, an efficiency of about 90 per cent was secured. It is now proposed to add about 2 per cent to the efficiency by utilizing the heat developed in the water of the reduction gear, for heating the feed water in its passage from the condenser to the boiler.

Steel Bulkheads Confine a Fire.—On the occasion of the last trip of the "Imperator" to New York, defective insulation caused an outbreak of fire in a provision room in the after part of the ship, which served to prove the value of steel bulkheads in limiting the spread of fire. The watertight bulkheads below and at the waterline should find their counterpart in fireproof bulkheads above the waterline. Our readers will be interested to learn that the fire was automatically made known by the issuing of smoke from the Rich Marine Fire Detector on the bridge. This device received the first Scientific American medal for safety.

Chilled Iron Car Wheels the Best.—In a paper read at the May meeting of the New England Railroad Club, Mr. A. A. Hale showed that, in the development of the freight car from 20,000 to 100,000 pounds capacity, all parts of the car have been increased in weight, but no part has shown such slight increase as the chilled-iron wheel. Car capacity has increased 400 per cent, the weight of axle 149 per cent, the weight of rail 100 per cent, whereas the weight of the wheel has increased only 38 per cent. In the opinion of the author, chilled-iron is the only metal of which wheels are manufactured which will stand up under extremely heavy loads without crushing or flowing.

Marine Diesel Engine Development.—Advocates of the application of the Diesel engine to large vessels, says Dr. L. K. Hirshberg, in *Power*, are endeavoring to curb to a degree the over-enthusiasm of radical supporters, who are prone to claim too much for this type of engine on account of the success of such vessels as the "Selandia." The short experience so far obtained with large oil engines on board ships (while eminently satisfactory and encouraging to the builders and owners), makes speculation difficult as yet; and the writer considers that further practical experience for a term of years must be had before accurate figures will be available as to reliability and upkeep.

Science

General Michael Rykatchew, the veteran director of the Russian Meteorological Service, has just announced his retirement. He has been connected with the Central Physical Observatory (the headquarters of official meteorology in Russia) for 46 years.

Moving Pictures in Medicine.—Press reports tell of the invention of one Dr. Rosenthal, which was submitted for inspection at a meeting of the Physiotherapeutics Congress at Berlin last spring, which rendered it possible to make cinematographic views of internal organs to provide an illustration of the workings thereof and to facilitate the localizing of disease. The invention is said to be an adaptation of the X-ray and is thought by some to promise great things in the way of diagnosis.

The Publications of the U. S. Department of Agriculture represent, in the aggregate, the most voluminous body of literature currently published by any scientific institution in the world. In order to meet the needs of scientific workers who now have difficulty in locating just the material they want in this great mass of publications, plans are on foot to establish an official research journal which will bring together all the results of important original investigations in the Department. Radical changes are also proposed in the plan of publication of the less technical literature of the Department, but the details of the changes have not yet been made public.

Ostwald's Annalen.—Some twelve years ago Prof. Wilhem Ostwald founded the *Annalen der Naturphilosophie*, as an organ open for the discussion of those questions of philosophy which have arisen in late years through the very rapid growth of scientific knowledge. Prof. Ostwald himself has taken much interest in the development of questions relating to sociology, or to be quite exact, "Kulturphilosophie," as the German term has it. Our readers may recall that one of the fundamental principles upon which Ostwald bases his system of "Kulturphilosophie," is that all our doings must finally be aimed at increasing efficiency, or in other words, decreasing wasteful effort. In view of the prominent place which this particular branch of natural philosophy has of recent years acquired in the circles of which the *Annalen* is the organ, it has been decided to change the name of Ostwald's *Annalen*, which henceforth will appear as "*Annalen der Natur- und Kulturphilosophie.*" At the same time Prof. R. Goldscheid has joined Prof. Ostwald upon the editorial staff of the *Annalen*. The sociological phase of the work will be mainly in the hands of Prof. Goldscheid.

Dried Yeast.—In the *Bulletin of Agricultural Intelligence and Plant Diseases* (Rome) Dr. F. Hayduck describes the remarkable development of the dried yeast industry in Germany during the past three years. Heretofore the thousands of tons of yeast produced annually by German breweries as a by-product in the manufacture of beer was almost without value, except for the small amount used in the breweries themselves to hasten fermentation of the wort. Before the days of compressed yeast much of this product was bought by bakers and housewives, but for many years brewers' yeast has been a drug on the market. As a food for livestock yeast has long been known to be valuable, but its utilization in this way has been limited by the fact that the fresh product spoils very quickly. The difficulty is now overcome by drying the yeast with the aid of machinery similar to that recently introduced for drying potatoes. Dried yeast keeps indefinitely, and is a remarkably nutritious food, not only for cattle, but also (after the removal of the unpleasantly bitter hop resin that it contains) for human beings. There are now twenty-six establishments engaged in the preparation of dry yeast, and the demand considerably exceeds the supply.

Aerology in the Arctic.—The plan of carrying on systematic upper-air observations with kites and balloons at stations surrounding the north polar basin, in connection with the similar observations that are to be made by the Amundsen and Stefánsson polar expeditions, has now reached a definite stage of progress. An international commission has been organized to direct the undertaking, consisting of Gen. Rykatchew (president), Prof. Hergesell (secretary), Capt. Amundsen, Capt. Ryder and Prof. Stupart, and a tentative programme has been drawn up. It is expected that stations will be in operation at the following points, and probably others: Nova Zembla, northeastern Siberia, Spitsbergen, northern Norway, Yakutsk, Verkhoyansk, Iceland, Greenland (two stations), northern Labrador, Franz Josef Land (Payer expedition which started August 10th), northwestern Alaska (to be established by the Carnegie Institution). It is recommended that all observations begin in the summer of 1914, the time of Amundsen's expected departure. Prof. Hergesell announces in this connection that the German scientific station in Spitsbergen, which is occupied chiefly with aerological investigations, will be maintained for at least the next three years.

Automobile

Agricultural Tractor Trials in Germany.—By way of celebrating the revolt of Prussia in 1813, the Königsberg Chamber of Agriculture is to hold a big agricultural exhibition with special trials for mechanical plows operated by internal-combustion engines. The tests are to take place the end of May and the first of June and particulars can be obtained from the Königsberger Landwirtschaftskammer.

Maxim Silencer for Gas Engines.—In patent, No. 1,060,925, Hiram Percy Maxim of Hartford, Conn., presents a silencer for gas engines which comprises reversely directed, eccentrically arranged and nested series of wide cylindro-spiral shells formed to provide a series of alternately reversing spiral-whirl chambers which gradually expand radially from the admission end and gradually contract toward a constricted discharge throat together with co-operating and supporting means which he utilizes in securing the desired silencing effect.

Motor Trucks in Tripoli.—According to information which appears in the Milan daily press, the Italian war department has been engaged in a series of very interesting trials with power wagons in the Tripoli region, and these proved such a success that the army is going very largely into the use of power wagons in the near future, it being desired to change over from horse wagons as completely as possible in view of the many advantages afforded by the automobiles.

An Automobile Improvement.—It is reported from Paris that the French authorities contemplate the adoption of a law or regulation making it obligatory to provide within an automobile some means whereby the occupants of the car, other than the chauffeur, can bring the car to a stop in case the chauffeur should become unconscious or otherwise disabled from handling the car. Attention has been especially called to the necessity of such an improvement by a recent accident in which a car ran overboard, when the chauffeur became unconscious, and resulted in the drowning of several children and other passengers of the car. Doubtless the application of such an invention would necessitate the provision of some means to prevent the operation of the safety devices except when absolutely necessary.

Camphor as a Vitalizing Agent.—Abroad, where great pride—and just pride—is taken in the mileage per gallon of fuel that can be obtained, a small band of motorists recently has been experimenting with gum camphor as a "dope" for gasoline. Usually, about one ounce of camphor is placed in five gallons of gasoline and it is stated by those who use the mixture that the operation of their motors is much superior with the camphor in the gasoline than without it. One motorist even goes so far as to claim that he has been able to increase his mileage per gallon as much as 20 per cent, though it would seem that the increase cannot be due to the use of the camphor alone. The idea is not new, of course, for Curtiss, at present of aeroplane fame, used it a number of years ago in his racing motorcycles and it is said he sometimes uses it now in his aeroplane engines.

Rubber Tires and Automobiles Are Different Goods.—The Court of Appeals of the District of Columbia in G. & J. Tire Company v. G. J. G. Motor Car Company has held that rubber tires and automobiles do not constitute goods of the same descriptive properties within the meaning of the trade-mark law. The decision quotes a previous decision of the same Court in which Mr. Justice Robb, speaking for the Court, said: "We think two trade-marks may be said to be appropriated to merchandise of the same descriptive properties in the sense meant by the statute when the general and essential characteristics of the goods are the same. The rule that the goods must be identical would defeat the purpose of the statute and destroy the value of trade-marks. The test is whether there is such a sameness in the distinguishing characteristics of the goods as to be likely to mislead the general public. If there is, only one mark should be registered."

Need for Standard Control.—What with new cars continually being brought out and new models of old cars periodically making their appearance, it would seem that there is abundant room for standardization in the construction of control units and particularly in the case of the gear-shift lever. At present, few cars are the same, and to make it even more difficult for the purchaser of a new model of the same make he already possesses, control methods often are altered radically. The Society of Automobile Engineers has made a laudable attempt to remedy the evil but it has not been altogether successful, probably owing to the fact that manufactures are loth to discard expensive jigs and tools in order to adopt a standard system. Still, a standard control method would be of material benefit to the owner for he would be able to drive his new car without preliminary instruction, regardless of how short the instruction might be, and what is even more to the point, he would be less likely to do the wrong thing, in driving a new car, from force of habit learned with the old one.

Bituminous surface maintained by one oil and three sand treatments annually.

Automobiles and Improved Roads

The Economics of Motor Traffic and of Highway Construction

By Logan Waller Page,

Director of the Office of Public Roads

Concrete construction. A well-built concrete road, although expensive, is cheaply maintained.

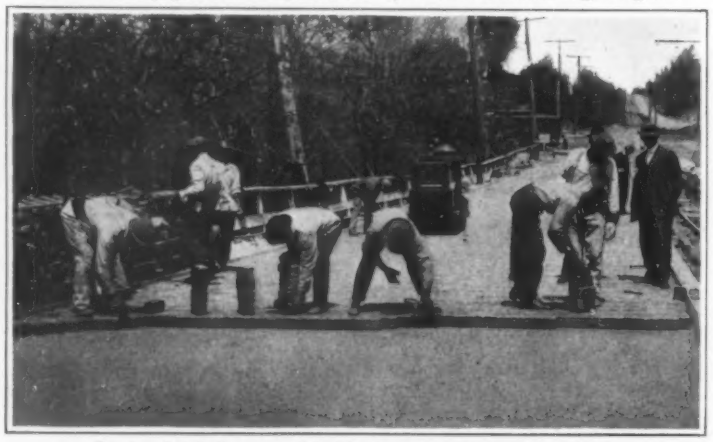
DURING the year 1912 automobiles paid in registration and license fees $5,638,878. This figure exceeded the value of exports of automobiles from this country in 1906. In 1911 we exported automobiles to the value of $15,924,361, exclusive of parts of machines. The corresponding figure for 1912 was $23,703,989. In 1912 we had nearly as many automobiles in New York State as there were in France and Germany combined. The total number of machines upon our highways last year was a round million. There is evidence at every hand of the enormous increase in every phase of automobilism in the United States. What is the relation of this great movement to our highways?

We have approximately 222,000 miles of improved roads. This mileage includes not only first-class highways, but a large mileage of graded and SURFACED natural soil roads. There is, therefore, an average of about 4½ motor vehicles to each mile of highway; and, with a daily run of 25 miles it appears that 113 automobiles traverse each mile of improved road daily. Colonel W. D. Sohier, chairman of the Massachusetts Highway Commission, does not expect waterbound macadam to stand up with more than 75 automobiles at high speed where there is a proportionate amount of light and heavy teams, approximately 150 and 250, respectively. Needless to say in the open country, with continuous stretches of macadam road, the automobile will proceed at high speed. Colonel Sohier's estimate of heavy teams is between 60 and 80, which represents suburban conditions, as it is a very high rate for heavy teams in districts less densely populated than Massachusetts.

We may expect, however, to find that our improved macadam roads are not withstanding the action of the automobile, and this is the case. Since the use of the automobile is increasing at an accelerated rate, and since, wherever a road is improved, it tends to draw increased traffic, we must avoid in the future the construction of water-bound macadam surfaces where heavy motor travel occurs. There are many places where such roads may be built with economy and confidence as to their service, but in the more densely populated areas this is not true. The construction of bituminous-bound macadam roads, concrete roads, and brick roads in the open country since 1906 is due almost entirely to the reaction of the automobile upon the old standard water-bound macadam surface.

There has been an increase in the cost of highway construction, and repair and maintenance. It does not follow, however, that this increase of highway costs in general is a relative increase per unit of travel. The traffic over our highways in motor vehicles is in general an entirely new and added item of travel. Only in the last two or three years have automobile trucks begun to replace horse-drawn vehicles for commercial purposes on the country roads. All hauling, until very recently, has been done by horse-drawn vehicles. The pleasure vehicle drawn by horses has almost entirely disappeared in most sections of the country, and the automobile has not only replaced it numerically, but has multiplied the number of pleasure vehicles many times. Our improved roads at present are sustaining, therefore, an amount of travel several times as great as they were ten years ago. The cost of our highways per unit of travel per year has probably not increased.

Traffic on clay gravel road (natural soil) near Fredericksburg, Virginia.



Laying brick for a road in Montgomery County, Maryland.

Boulevard near Spokane, showing permanent character of rip-raped fill.

Laying bituminous concrete, Hillside Avenue, Jamaica, New York.

The High Cost of Waterbound Macadam Road.

We have not been building improved highways in this country very long. Before 1893, there was no systematic highway improvement. Not until recently have we been able to determine the cost over a period of years in this country of any of the standard types of roads. The waterbound macadam road was a more expensive road than was generally admitted. It was not customary to add the annual cost of periodic resurfacing to the annual maintenance figures. When that is done, it is found that the water-bound macadam road, 15 feet wide, costs approximately $500 per mile per year, or between five and six cents per square yard. The substitution of bituminous bound macadam surfaces for water-bound surfaces, has increased the first cost of construction from 20 to 40 cents per square yard. It has apparently increased the cost of annual maintenance and, at present, we cannot say to what extent the annual cost of periodic resurfacing will be affected by bituminous construction. There are, however, a great many instances on record which indicate that the total upkeep of bituminous macadam roads will exceed $600 per year in the long run.

As we pass in review the various standard types of improved highway surfaces, we see that the cost of their maintenance and repair tends to increase with the cost of first construction. This law, however, does not apparently hold for the most expensive roads such as well-built concrete, and brick roads, or bituminous with concrete foundation, the questions that is rapidly taking shape in the minds of highway engineers is that of the relative first cost of construction and the cost of annual repair and maintenance for a given period of years. Shall we greatly increase the cost of our road surfaces and avoid high annual charges for repair and maintenance

During the season just closed, the United States Office of Public Roads has built a number of sections of experimental road at Chevy Chase, Maryland. These sections are of the highest types of road construction now known to highway engineers. They include two sections with wearing courses of bituminous concrete on cement concrete foundations six inches thick; several varieties of concrete sec-

(Concluded on page 200.)

Ranschburg's apparatus to study a child's visual learning. This apparatus provides for a rhythmic successive learning of visual stimuli.

Efficiency in Learning

A Practical Result of Experimental Pedagogy

By Dr. P. R. Radosavljevich
New York University

Dynamometer and aesthesiometer by means of which is studied a child's strength and sensibility after a period of mental or physical learning.

THE best way to show the dimensions and force of Experimental Pedagogy is to present its practical results. Like other great movements, experimental pedagogy has overflowed the traditional channels of academic work and has become a new popular force. Its watchwords are: "*Hygiene of Teaching*" and "*Economy of Learning*," ideals that the newer pedagogues are trying to attain with the least expenditure of energy. In order that they may be attained the teacher (1) must be at home in his or her own school branch, (2) must know and practise the best way to present school material in the classroom, and (3) must show the pupils how to study most economically.

Saving the Energy of the Teacher and Pupil.

Let us suppose that the first two conditions are fulfilled. According to the ideals of the old pedagogy such

TABLE I

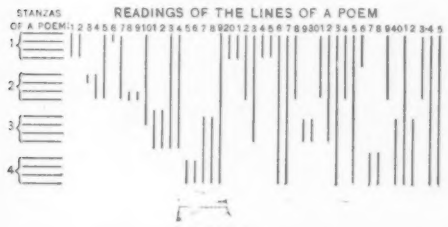
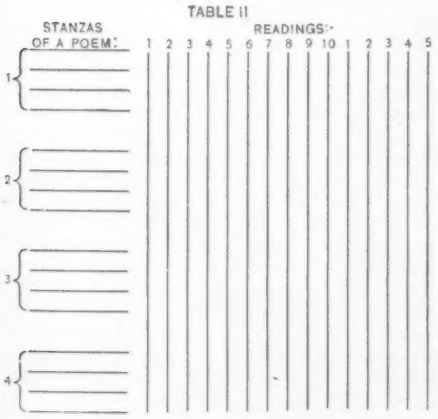


TABLE II



a teacher simply did his best. But modern education is not satisfied with that alone. Experimental pedagogy asks the maximum from teachers, i. e., the most economical way of learning or acquiring a school material explained and understood. Let me illustrate that by an actual experimental case.

A 9-year-old boy of average intelligence was asked, after certain preliminaries, to learn a poem with four stanzas of six lines each, with the instruction to memorize each part as quickly as possible, and to read aloud and recite aloud until enabled to execute one errorless recitation. The experimenter, who had copies of the poem, designated the part which the child read by a vertical line on the right. So, for example, if he read four lines twice, two vertical lines were drawn on the right; if next he reads two lines, a third vertical line of a length equal to the space occupied by two lines was drawn. If we represent the lines of the poem by horizontal lines, then the whole procedure appeared as shown in Table I.

The length and succession of vertical lines show that this child needed 26 repetitions to commit it to memory, that he divided the poem into parts, that he repeated the parts already learned by going back occasionally while learning later parts (either to avoid them or in order to associate the parts with one another), that the first lines were repeated oftener than the last ones, and that the difficult parts (or words) were learned by means of special repetitions. This is the old, the usual, the uncontrolled, the uneconomical method of learning, a memorizing left to accidental success and planless efforts. This is called "*the part method*," "*piece-meal*," or "*cumulative*" or "*fractional*" learning.

A week later the same boy was asked to learn a similar poem (both in quantity and quality) with the instruction to repeat it always from the beginning to the end until it was learned. The following graphic representation (Table II.) shows the results:

Here the same child needed only 15 repetitions, and his reproduction was more uniformly associated; he avoided too many or too few repetitions upon respectively easy or particularly difficult lines or verses. This method of learning is called "*the whole method*" or "*the complete method*."

Both the piecemeal and complete learning agree only in the fact that the child commits to memory in *one sitting*, i. e., a poem is learned in one day without interruption of time intervals between repetitions.

A week still later the same pupil learned a similar poem, but in this case the child repeated the poem—by the whole method—only once a day. The time of day was 9 A. M., the same as in the previous two experiments. The results are shown in Table III.

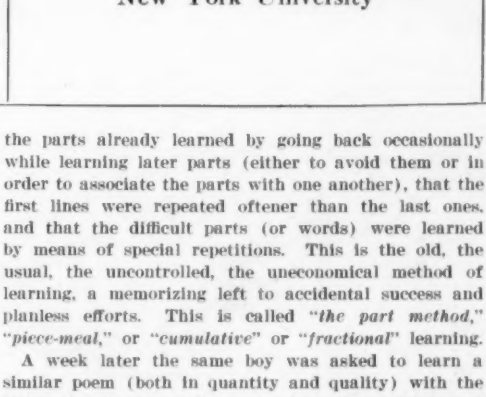
Compared with the previous two methods this plan of learning proved still more economical; only 8 repetitions were required. This method may be called *distributive whole method*. Its value has been demonstrated experimentally by Zost, Meumann, Ebbinghaus, Magneff, G. E. Müller, Pentschew, etc. Zost found that 2 repetitions on 12 successive days were better than 8 repetitions on 3 successive days. That this method is most economical and most natural is also proven by the fact that the Servian *guslars* (national folk singers) learn a national epic or lyric song (sometimes 500 to 1,000 lines long) by distributive whole method only, i. e., by listening to the recitation of another *guslar*. This method of learning is used also by the Greeks in committing to memory long Homeric poems.

To ascertain the value of these three methods, the results are tested after a certain time interval. I asked the same child to *relearn* the same three poems after 28 days. All these experiments were carried out in Meumann's laboratory at Zürich. The results are shown in the following table:

Method.	First Learning	Relearning.			
	Number of repetitions.	After an interval of ——	Number repetitions to relearn.	Saving.	
				Absolute	Per cent
		Days.			
1. Part method	26	28	10	16	38.4
2. Whole method	15	28	6	9	60.0
3. Distributive Whole method	9	28	2	7	77.8

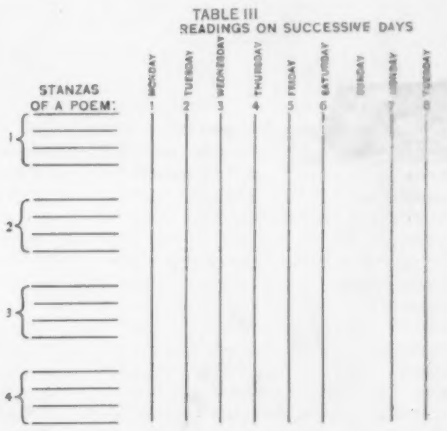
From this table it is seen that the percentage of saving in relearning is greatest in the distributive whole method (77.8 per cent), less in the whole method (60 per cent), and least in the part method (38.4 per cent).

These results were verified also in a more homogeneous material for learning, in so-called *nonsense syllables*, e. g., lel, rit, fos, zam, ped, des, etc. These



This is the arrangement of apparatus used in child's learning of nonsense syllables. The syllables are fixed on the cylinder that rotated so as to expose one syllable at a time through the opening in the screen.

TABLE III
READINGS ON SUCCESSIVE DAYS



syllables provide little attraction to the memory, because they are almost devoid of associations, i. e., they are neutral material in learning experiments. In memorizing such syllables my 28 subjects read them in a regular succession, by means of a special apparatus, (see accompanying illustration). Of course, the words whose meanings are unknown, are memorized and relearned with more or less difficulty for all manner of reasons, but the relative values of these three methods is the same as in the case of poems.

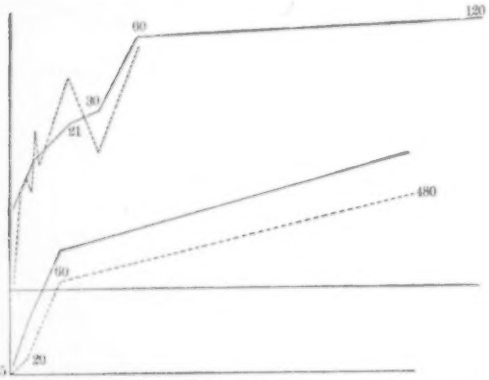
The Influence of Age.

Age is another such secondary factor. I found, e. g., that the above mentioned boy needed 63 repetitions to commit to memory (by the whole method) a series of 12 nonsense syllables, and an adult (a university student, 22 years old) needed for the same series 13 repetitions only. Consequently the popular opinion that children memorize more quickly than adults is erroneous. The child's superiority consists only in retentiveness, i. e., a child needs less repetitions to relearn material once memorized, but the number of repetitions required for learning the first time is greater for young children. In other words, adults surpassed children only when the work was prolonged, but children needed less repetitions in relearning.

Another secondary factor is the time elapsed between first learning and relearning. I found that the time saved in relearning decreased with age for all but the

5- and 20-minute intervals, as it is indicated in the following table and diagram:

Relearning after	Per cent of Forgetting for 27 subjects.			
	16 Adults.		11 Children.	
	Nonsense Syllables.	Poems.	Nonsense Syllables.	Poems.
5 minutes	2.5	0.0	8.8	1.7
20 minutes	11.4	3.9	14.6	5.5
1 hour	29.3	21.7	22.7	17.9
8 hours	52.6	41.9	37.0	35.3
1 day	31.1	20.3	28.3	20.7
2 days	39.1	33.2	31.9	28.2
3 days	——	43.5	——	——
4 days	——	45.5	——	——
5 days	——	43.5	——	——
6 days	50.7	57.6	42.4	40.7
7 days	——	50.0	——	——
14 days	59.0	70.0	46.1	45.3
21 days	62.2	52.4	49.5	55.5
30 days	79.8	76.1	66.2	71.9
60 days	——	——	94.3	85.4
120 days	97.2	——	——	——



The curves below show forgetfulness during the day (after 5, 20, 60 and 480 minutes); the curves above show the forgetfulness after 1, 2, 3, 4, 5, 6, 7, 14, 21, 30, 16, and 120 days. In both cases the broken lines represent forgetfulness for poetry, and the continuous lines show forgetfulness for meaningless words. The children lost association strength somewhat faster than the adults; the association strength at the end of one day was greater than at the end of 8 hours or at the end of 2 days.

Another factor is the child's *general intelligence*. A bright child, on the whole, needs less repetitions than a dull one, but the latter retains better.

The *mental* type of the learner counts also. Although all my subjects experimented upon were of mixed mental (or ideational, memory) type, it was a great help to each to follow his or her own predominant type of memory with which few seem to be familiar.

How Rhythm Affects Memorizing.

Rhythm is one very important element in all kinds of learning; it forms an extra association between the varied stress it brings and the syllables so stressed. All learners are inclined to use rhythm and tempo, trying many at first and focusing later to a few; distinct injury is caused to the memory of anything once acquired when it is relearned in a different rhythm. Of course the rhythm suitable to what is to be learned should be adhered to strictly. In learning lines of unconnected words and parts of a poem, Ebbinghaus found that a rate of 200 iambics per minute or 0.3 second for each measure is the most advantageous; and in learning the same lines 24 hours later, he also found that those lines had been better retained which originally were learned with greater speed. Meumann and Pentschew found that, in general, for adults half-aloud learning (of nonsense syllables) is more favorable, for children silent learning or that with repressed voice.

Practice has a great effect. I found that the number of repetitions necessary both to learn and to relearn diminishes with time, but the growth of practice is far greater in learning than in relearning. I found that a special practice in memorization improves memorization in general. This is also shown by the experiments of Meumann and Ebbert. I also found that there are distinct slow and fast types of learning, although the former may by practice approach to some extent the latter, so that the difference may be due to practice.

The Will to Learn.

Of course in every method of learning the *will to learn* is essential. A striking instance for that is shown in my experiments. I gave a foreigner who understood no German a series of nonsense syllables. This subject not understanding the directions, read the syllables 46 times without committing to memory. When I asked him if he could repeat the series he exclaimed: "What! Am I to learn them off?" Then with 6 repetitions he memorized them.

Meumann and Mayer tested the ability of school children *to work alone* or *in company with others*, and found, in general, that the work of pupils in groups (in the class room) is superior to their work as individuals (working alone in the class room). Schmidt found, generally speaking, that the quality of the *home work* is inferior to the *school work*.

Many have tried to show that learning is influenced by the sex, correlational, diurnal, weekly, monthly, and seasonal factors. But there are many crudities of method and trivialities in the way of such results, because many people are attempting kinds of work in various fields for which they are totally incompetent. Of course every great movement floats many faddists, who are really irrelevant in the problem of economy of learning, this great postulate in modern school education.

Emergency Repairs to a Destroyer

By J. F. Hellweg, Lieutenant Commander U. S. N.

DURING the last winter's maneuvers of the Atlantic Fleet off Guañtanamo Bay, Cuba, two of the destroyers collided about twenty-five miles off shore. The "Burrows'" bow was twisted to port about eighty degrees and was badly crushed, as shown in one of the front-page photographs.

This injury, while not endangering the safety of the ship, effectively prevented the "Burrows" taking any further part in the fleet maneuvers. Had such an accident occurred during wartime, the ship could not have been operated and, had she been chased, she could not have escaped, as her speed was practically killed. A destroyer in such condition would sadly handicap the flotilla and the fleet, since she would require protection and could only make about six knots.

While returning to Guantanamo Bay, plans were outlined for repairing the bow and were submitted to the Flotilla Commander shortly after our arrival in port.

The next morning the ship was placed alongside the dock on one of the numerous cays in Guantanamo Bay, all weights, including anchors, chains, ammunition, fuel oil, fresh water, stores, etc., were shifted aft, and the cutting out of the rivets on the stem was commenced.

We knew that the ship's keel was broken short off about two feet abaft of the scarf of the keel and stem; but the ship's weights were not sufficient to raise the bow so that the break could be reached. A large anchor was therefore landed on the stern to lift the bow. The ship was then run inshore till the forefoot took on the cradle of a small marine railway used for repairing launches, small tugs and barges, the ship being steadied by large barges on both sides. By this means, the bow was placed in water about four feet deep at low tide.

To permit the use of air tools a small air line was piped from the ship's air compressor to the bow, and was rigged with three outlets. Air tools were borrowed from the fleet, and the men were arranged in shifts to push the work as rapidly as possible.

Scaffolding was built around the bow with target-raft material, and the ship's searchlight was dismounted, taken on the beach and mounted so that the light could be thrown on the work.

Men from the U. S. S. "Dixie" and the U. S. S. "Monaghan" helped the crew of the "Burrows" throughout the repairs. As the keel had been broken short off about two feet abaft the scarf of the stem, the latter was all clear for removal as soon as the rivets had been cut out of the side plating. The stem was dropped overboard and hauled up on the beach, where it was straightened. Owing to the lack of facilities, the stem had to be heated and straightened in spots, the twists being gradually worked out of the stem. This straightening, under the existing circumstances, was a fine example of what an American bluejacket can do with little or no facilities or tools at hand.

The port plating was so badly twisted and torn that none could be saved. The starboard plating was heated by a large blow torch and hauled back into place by tackles. Some of the upper plating on this side had to be renewed. The ship's frames were so badly crushed that they were thrown away.

After the straightened stem was swung into place, it projected about eighteen inches above the level of the deck, this being due to the latter's having been pulled down at a sharp angle when the stem was twisted and the keel broken.

It was impossible, at first, to raise the deck; but, by slitting the bulged plating close up to the deck on both bows, the forecastle deck was jacked up into place and the stem bolted in position. The starboard plating was riveted in place and the port plating was then built up by sections.

The broken parts of the keel were chipped off flush, butted together, and then secured by a shoe of ⅝-inch boiler iron and eight through bolts, as shown in sketch.

The discarded ship's frames were replaced by oak stringers and breast-hooks. These were put in position, wedged apart snug against the skin of the ship, and secured in place with through bolts as shown in the sketch. Cement was poured in through the filling holes, making the whole system solid and secure. The oak stringers and breast-hooks were alternated in building up the bow.

In ninety-one working hours, the bow had been entirely cut off and rebuilt. The ship was taken to Hospital Cay at 10 A. M., March 7th, 1913, and backed herself off at 1 P. M. March 14th, 1913, ready to take her place in the fleet and run at any speed.

Inquiries have been made, and this appears to be the first time in our Navy that such a job was ever undertaken by a ship's company. The crew averaged thirteen hours a day in repairing the bow, some of the men working in water halfway between their waist and shoulders for hours at a time. With the assistance of the searchlight, the work was pushed till a late hour every night, when it was possible, and the enthusiasm and cheerfulness of the men was such as to make one proud of the American bluejacket.

During the maneuvers the day following the completion of repairs, the "Burrows" ran at high speed into a good sea with no trouble. A month later she entered the quarterly full-speed race and maintained her previous position as the fast boat.

The American public never hears how the young Americans who serve their country in the Navy rise to any situation, and perform unexpected duties quietly and efficiently without thanks or commendation—duties which, in wartime, would attract the attention of every one in the United States and win for them the thanks of their fellow countrymen.

A Railway in Iceland

AT present methods of travel in Iceland are of the most primitive description; a few carriage roads exist in the south, with bridges over the rivers, but generally throughout the island journeys are made on horseback, over bridle-paths or no paths at all, and streams have to be forded. A few years ago the Althing (national assembly) voted funds for surveying the route of a railway from the capital, Reykjavik, in an easterly direction through a comparatively populous and thriving region, and one much frequented by tourists. Plans are now complete for this line, which will run from the capital over the Thingvalla plain to the Olfusa bridge, a distance of about fifty-eight miles. The estimated cost of construction is $1,000,000. Ultimately it is proposed to extend the line to Thorsjaa, with two branches from that point, one leading to the geysers, and the other to Oerbak. The railway project has led to ambitious plans of drainage and irrigation along the proposed route, opening up extensive pasture lands and enlarging the already important dairy industry of the country. To the tourist the railway will offer an agreeable substitute for the present tedious journey by pony to the geysers, Mount Hecla, and other points of interest.

Hawker's Failure to Win the Daily Mail Prize

HARRY A. HAWKER, the solitary entrant for the *Daily Mail* prize of $25,000, offered for a flight in a hydroaeroplane around the coast of England and Scotland, came to grief 15 miles north of Dublin on August 27th. He had then covered 1,043 miles of the total of 1,540. At Oban one of the floats of the machine had to be repaired. Engine trouble brought Hawker down off Argyllshire. After crossing the sea to Larne, further adjustments of the engine consumed an hour and a half. He ascended again and flew steadily for two hours and a quarter, when, curiously enough, the slipping of his rubber-soled boot caused him to lose control of his machine, so that he plunged into the water from a height of fifty feet, near the shore. Hawker was only bruised, but his mechanic's arm was broken. The machine was hopelessly wrecked. It is said that the *Daily Mail* will present £1,000 to Hawker in recognition of his brave attempt.

The Current Supplement

IN this week's issue of our SUPPLEMENT Prof. E. L. Schwarz contributes an article on new types of volcanoes in Iceland.—The production of synthetic tanning is reported, and may prove of considerable interest to the leather industry.—E. J. D. Coxe gives us an illustrated description of Open Air Coal Mining as carried out in Pennsylvania.—W. A. Nicholson contributes an article on bird calling, which is illustrated with pictures of different forms of whistles used to imitate birdcalls.—The second installment of Lieutenant Colonel Kuhn's article "Some Aspects of the Subject of Transportation" deals with traffic by water.—John C. Parker writes on the industrial use of synchronous motors by central stations.—Prof. E. E. Barnard puts on record for future observers the present appearance of some temporary stars.—Charles Kassel contributes an article on Heredity and Genius.—The views, ofttimes quaint, held by prominent thinkers of the past and present regarding the seat of the soul, are reviewed by Dr. D. F. Harris.—An important discussion on the sources of motor fuel held at the British Motor Transportation Conference, is reported in this issue.

Patents and Modern Industrial Conditions

The Stimulus of Patent Protection

By Frederick P. Fish

EXPERIENCE has demonstrated that no form of reward so fitted the achievement, was so productive of advantage to the community and was attended by so few disadvantages as the grant to an inventor of a monopoly of his invention for a limited time. While many other forms of reward have been suggested (such suggestions were made at the convention which adopted our national constitution), they have nowhere been adopted as part of the machinery of society. Everywhere some form of exclusive control for a limited time has been recognized as the best way of dealing with the matter.

The encouragement of patent protection does not alone stimulate the inventor to intellectual effort; it excites to strenuous effort a long line of intermediaries, capitalists, investors, business administrators, licensees and users who work with or under the patent and whose co-operation is vitally necessary that the invention may not be confined to a paper description, but may actually get into use.

After all this line of public servants has been rewarded, the ultimate consumers get their advantage from the invention, even during the term of the patent, in the form of less cost, added facilities, increased comfort and greater convenience; and their gain, while the patent is in force, is undoubtedly in almost every case infinitely greater than that of those who profit directly from working under the patent. Of course, when the patent expires the invention is free to all.

Until 1888 Switzerland had no patent law. It was argued that, situated as Switzerland was, in the heart of the industrial world, with a docile and intelligent population, trained by an admirable system of education, and with the great advantages by way of water-power which the country possessed, it could progress more rapidly if its citizens were all free to appropriate for the national industries the ideas, patented or unpatented, of the rest of the world, without the grant of any monopoly to individuals in Switzerland itself. This policy was, however, found to be short-sighted and ill-advised. The Swiss were not encouraged to invent. More than that, they were not encouraged to adopt and introduce inventions. They did not develop the desire to improve. Because they had no patent system, their industries did not advance satisfactorily.

Under the stress of the necessity that inventions should be fostered in the community, if industrial progress in competition with that in patent-granting countries was to be secured, a patent law was adopted in 1888. Since then there have been over fifty thousand patents issued in Switzerland and her industrial progress has been marked.

Holland in 1869, before the extraordinary expansion of the latter part of the last century had even begun, abolished her patent law, undoubtedly influenced by the hope that her situation was such as to make it more for her interest to take freely the inventions made anywhere outside of her own boundaries than to attempt to develop inventions and the inventive habit among her own people. It is significant, however, that she has, after trying the experiment for more than a generation, recognized its futility and has now again established a patent system.

Inventors Helpless Without Patents.

Nowhere can it be worth while to invent, unless there is opportunity for utilizing inventions if made. If every citizen were an Edison, it would not profit him to work out new ideas on paper or in a laboratory unless the conditions were such that they could be introduced into use with the chance of a proper return. The inventor therefore is helpless unless he has something to offer the manufacturer or the capitalist that will justify the latter in paying for rights to the invention. An adequate patent system gives to the inventor, who as a rule never could himself do anything with his invention, something that is tangible and of value, which he can transfer, in whole or in part, to the business enterprises which alone can make the invention of value to the community. Inventors, and business men who develop inventions and introduce them to the service of man, to exactly the same degree and for the same reason are stimulated by the protection afforded by a patent, to efforts which they would never otherwise make. Each class would be helpless without the other. It is only when both are encouraged and protected, as they are by the grant of a patent, that the progress of the useful arts is promoted. Even if the invention meets a real demand, there is frequently the opportunity and occasion for the expenditure of a vast amount of money and of the greatest intelligence and energy on the part of those who are introducing it into use before commercial success can be attained and always there is the chance of utter failure.

Under these circumstances, neither in Switzerland or Holland, nor elsewhere, could capital be expected to take up and push new inventions under conditions, where, if success were achieved, the full benefit of the invention would necessarily be immediately shared by all competitors.

In fact, competitors would have a great advantage over the manufacturer or the capitalist who bore the brunt of the preliminary development. They would have borne no part of his burdens and expense, but would, without cost, adopt from him the perfected thing to which he had devoted so much energy and in which he had made such a large investment. They would reap where he had sown. Under such conditions even the most brilliant inventor cannot get the help which he must have.

The effect of a sound patent system is to overcome these obstacles to the development of inventions, to encourage men to invent who would otherwise have very little reason for inventing, and to attract business men to the arduous task of perfecting and introducing inventions when otherwise they would be inclined to leave them severely alone.

Superiority of American Patent System.

The standards and rules imposed by foreign patent laws as to working inventions, and as to the grant of compulsory licenses, are and must be purely arbitrary. Even if wrong in principle they may operate reasonably well as to some inventions. But in so far as those provisions operate they are fatally destructive in many cases and no man who is inclined to invent or to promote invention can be sure that any particular invention will not be one of a class that is necessarily rendered unprofitable because the law fails to give him a free field for effort during the term of the patent.

After a somewhat careful investigation of the situation in foreign countries, I am satisfied that the so-called working clauses and compulsory license clauses of foreign patent laws are hostile to the real public interest, and that they operate greatly to the discouragement of invention and thereby distinctly stand in the way of the sound development of the useful arts. I believe that the simple provision of the United States patent law that after the grant of his patent the patent owner shall control the invention absolutely for a short but definite term, having no more payments to make and no fear of interference from competitors, during the term, gives to our people a far greater stimulus to invention than does the law of any other country.

The result is that to-day there are not only a very large number of men struggling with inventive problems or who are on the lookout for the opportunity to invent, but the effort has been systematized to a large extent in accordance with the scientific principles upon which modern business is carried on. With the large enterprises of the country, invention is as much a part of the systematic organization of the business as manufacturing or selling. Intelligent men are employed to determine the problems of the business and to find in what direction improvements should be made that there may be extension into new fields, increased production, greater economy, or an improved product. Highly trained engineers and inventors attack the problems as they are presented and work them out in well-equipped laboratories where not only technical skill, but thorough scientific investigation, carried on almost regardless of expense, are applied to their solution. Meantime, as always, individuals, even the most humble, are inventing or hoping to invent. They know that nothing is more likely to advance them in wealth and comfort than an invention, the opportunity for which is wide-open before them, reward in proportion to the merit of what they may accomplish, being almost more certain than in any other field of human endeavor.

Patent System Imperative Under Present Unstable Conditions.

Continued and incessant industrial improvement is essential to our well-being. In the practical arts there is no such thing as a stable condition that can be relied upon as permanently satisfactory. Unflagging invention is required at every stage of progress.

Up to a recent time our situation in all respects has been such as to promote industrial development. We have had as a background for it an enormous amount of free land which was open to cultivation. This has now been practically exhausted. This circumstance affects our industrial situation disadvantageously; but it had to come. We must use every weapon to neutralize the loss of this asset.

The prevailing popular sentiment of to-day and the new laws and new interpretation of old laws based upon that sentiment are such as to require a definite readjustment of business and of business methods in all their relations. But the process of readjustment will surely be one of shock to our industries. They will endure, even if they could never have grown to their present proportions had the ideas of to-day prevailed fifty years ago. It is, however, clearly a time in which we should hold on to any feature of our social organization that is right.

Foreign competition is sure to be more serious every year. To-day, except for the artificial protection of tariff laws, the whole world, because of improvements in transportation facilities due to invention, is in immediate competition. No industry can thrive in any country unless that country has peculiar advantages, either natural or acquired, so as to be able to produce at such low cost as to meet the competition of other countries. The natural advantages of the United States are great in some directions, but are by no means controlling as to many of the industries. In our competition with foreigners we are hampered in many ways. In our cost of production we are embarrased by the high cost of our labor as compared with other countries. We have in the past more than held our own in international competition, partly because we have surpassed all other countries in shop and business organization, but chiefly because of our superiority as inventors and in the quick and comprehensive adoption of inventions. If the process of continuous improvement is checked, we shall lose this advantage and there will be no alternative except the destruction of some or many of our most important industries or a reduction in the wages and standard of living of our workmen.

The opportunity for improvements based upon invention is in many branches of industry growing less every year. There is no longer room for the striking advances in agricultural machinery, machinery for making fabrics and shoes, electrical and other power apparatus, machinery employed in the production and working of wood and metals and in other great departments of industry that there was a few years ago. It may almost be said that many of the arts are already developed almost to the point of saturation. It is not so easy as it was to find out how they can be improved and to improve them. There should be every possible incentive to seek out and to develop an incessant series of minor improvements which may in the aggregate afford great possibilities of advancement. The latter are of a kind that especially requires encouragement, for they do not greatly appeal to the imagination and the direct returns from anyone of them are not likely to be large. They are not often developed as the result of a happy thought. Close and careful study and scientific effort carried on persistently, systematically and at great expense is generally required for them. Agriculture and the production of food products may be revolutionized during the coming century by chemical inventions. In other fields there is room for many great and important improvements, which cannot be realized unless our patent system affords the requisite encouragement.

More than ever, when there are causes at work which depress enthusiasm and hold back development.

The Oldfield Bill that has been reported by the Committee on Patents to the House of Representatives at Washington is a most serious attack upon our patent system.

Any provision in the law preventing the imposition of conditions as part of a sale or license of a patented article or of the contract authorizing its manufacture or use, or any requirement that would impose a penalty if the invention was not manufactured, and particularly any requirement by which under any circumstances a license to use the invention could have been acquired for the asking by a person or corporation to whom the patent owner did not wish to grant a license would undoubtedly have checked invention and the development of inventions to a marked degree. The testimony before the Oldfild Committee of those familiar with the subject is practically unanimous on this point. And yet it is just such an inroad upon the established law of the land that characterizes the Oldfield Bill.

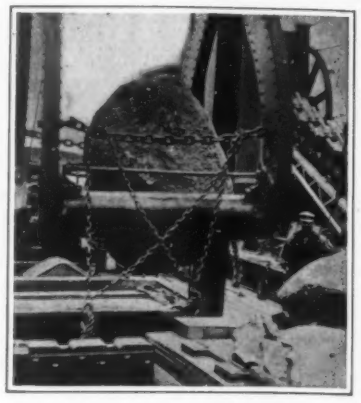
The community as a whole, requires for its prosperity an adequate patent system. I believe that ours is adequate, that it would be a national misfortune if it were weakened as proposed by the Oldfield Bill.—*Address delivered September 2nd, 1913, before the American Bar Association, Montreal, Canada.*

Cutter head of hydraulic dredge, showing knives.

St. Lawrence Ship Channel Improvements

Constructing a 35-foot Channel Between Montreal and Quebec

By Harry Chapin Plummer



Stone lifter raising boulders at Cape Charles.

WHEN the season of navigation on the St. Lawrence River closed last fall the dredging of the ship channel between the Traverse, at the eastern end of the Isle d'Orleans, below Quebec, and Montreal, a contracted distance of 220 miles, was half completed, at a total cost of close upon $15,000,000. As showing the determination with which the great task is being prosecuted by the Canadian Ministry of Marine and Fisheries, it need only be cited that, having accomplished the opening of a 30-foot channel for 60.60 statute miles, of a total mileage of 63.35 between Montreal and Cap à la Roche, and the deepening of the Beaujeu and St. Thomas channels, below Quebec, to a depth of 30 feet at extreme low tide, work is being rushed upon a 35-foot channel, also between Montreal and Quebec, a distance of 6.97 miles of which is now completed. Likewise, a good start has been effected upon the north channel below Quebec, which it has been decided to deepen to 35 feet at extreme low tide. The south channel below Quebec has already been deepened to 30 feet and opened to navigation. From 1851, when the first real attempts were begun upon the improvement, to March 31 of the present year, the sum of $14,524,555.51 was expended and the number of cubic yards dredged totaled 78,231,531.

It is figured that the average load-line draught of fifty modern vessels is more than thirty feet, and one authority holds that there are only two, or at most three, ports in the world accessible to them. One of these, of course, is New York. The situation of the St. Lawrence ports of Montreal, Quebec, and Three Rivers is regarded by the Canadian authorities as decidedly advantageous, even though the thirty feet may at no distant time be deemed mediocre. The new improvement, doing away with the probability of delay and accident to ocean shipping, must greatly advance the position of the three ports, and further improvements to the St. Lawrence River, to give any reasonable depth by dredging, must, as a result of the work now progressing, prove to be not only feasible, but obtainable at much smaller cost than for many rival ports, and it will require virtually a nominal cost for maintenance. At the present time, a fine channel of thirty feet at extreme low water, has been accomplished between Montreal and Cap à la Roche, while similar depth is to be had between the latter point and Quebec, by taking advantage of the tide. It is estimated that the low-tide channel will be completed as far east as Quebec before the end of another year.

The completed channel has a minimum width, in the straight portions, of 450 feet, and on the curves, of from 500 to 800 feet. The channel does not afford the usual difficulties of canal navigation. There is sufficient water on the banks to minimize induced currents, which, when the cross section of the passing ship is large, in proportion to the cross section of the channel, render safe steering at ordinary speed difficult.

The success of the work is in great measure due to the geographical situation of the route, to the physical features of the river favorable for improvement, to the determination and public spirit of the business men and industrial corporations of Montreal, and to the recognition by the government of Canada of the national character of the project. Yet another factor which has contributed to success is that the ship channel elevator dredges employed in the work, which have earned for themselves a wide reputation, have all been designed and built at the government shipyard at Sorel, on the south bank of the St. Lawrence, between Montreal and Three Rivers. Their construction has not been competitive, nor yet cheap; only the best material has been used, and the most careful workmanship. The dredges are both massive and strong, with a resulting capacity of 6,500,000 yards per annum, much of which has been put to test in exceedingly hard material.

Stone lifter with grips capable of bringing up 50-ton boulders from the river bottom.

Shale rock, dredged without the aid of explosives at Cape Charles.

Section of discharge pipe, showing ball sprocket spring joint between each length of one hundred feet.

Because of the fact that the St. Lawrence River has its real source in the Great Lakes, it is probable that there is no river in the world so well adapted for improvement. The usual condition of a river presents steep slopes at the source, which erode the banks and transport coarse material. This, as the slope becomes more gradual, decreases, until at the mouth of the stream the water carries in suspension a fine sediment, which deposits to the great detriment of navigation. Such has been the geological and geodetic history, for instance, of the Hudson and the Mississippi. In the St. Lawrence the material from most of the sources of supply is all deposited in the settling basins, the Great Lakes, and from there to the ocean the bottom of the river is usually hard, so that not only is the water clear, but the bed is permanent, and except for floods during the ice accumulations, the fluctuations in level are gradual, and not excessive.

In the ship channel the material to be excavated varies from soft blue clay, into which a pole may be planted some six or seven feet by hand, to stiff clay, to hardpan as hard as a macadamized road, and to shale rock and large boulders. In one or two localities coarse sand is found, at which points dredging has to some extent to be repeated.

The dredging operations undertaken in the course of the improvement do not either theoretically or practically lower the level of the water. No material is removed; it is merely taken from one place and deposited in another. So long as the water supply remains the same, the same level may be relied upon. The nature of the material composing the bottom of the river, although in many places very difficult to dredge, is, for the same reason, of such a character that a dredge cut, once made, is substantially permanent.

The currents of the St. Lawrence are, for a river of such size, not only reasonable and regular, but altogether free from the usual dangers to navigation resulting from freshets. The winter season, with its ice and snow, is the one great drawback to the St. Lawrence. The successful work accomplished by the ice-breakers during the last two years, however, proves

that the navigation season may be materially lengthened.

A noteworthy feature of the work is that it has been prosecuted in a more or less swift current and without interruption to the almost constant navigation traffic of the river. The dredges are operated, during the season, 132 hours per week, or steadily from midnight on Sunday until noon on Saturday. Only two holidays —Dominion Day and Labor Day—are observed. Stops are made only for bad weather, for repairs, for shifting from one place to another or to allow room for passing craft. Coal is supplied by barges without stopping the work. The steady work at a depth of from 32 to 42 feet in very hard material, which is increasing in its resistance as progress is made toward Quebec, and is very taxing on the machinery and equipment. Only a well designed and strongly constructed plant could stand the strain. A dredge capable of removing 6,000 yards per day of soft material undergoes a relatively greater strain by the dredging of 1,000 yards of hard-pan, in which boulders are embedded. A notable increase in the expenditure for operations of late years has been due to the advanced cost of supplies and repairs, wage raises and the greater cost of dredging in hard bottom.

About four hundred men are employed in connection with the dredging operations, all of whom are sailors, born and brought up at Sorel or at some of the parishes bordering on the river. Most of them have been trained to the service from boyhood. The senior captain of the fleet is credited with the statement that he has never earned a cent in any other service. This training of the labor employed has undoubtedly been a factor in the orderly and successful accomplishment of the task, which requires extraordinary care and skill and indomitable patience, the machinery being forced to the utmost, and passing vessels having constantly to be watched for.

As a portion of the channel is finished, it is thoroughly swept with the testing-scow, and if it is proved clear it is immediately opened for navigation. The problem of thoroughly sweeping the channel is one of great importance and considerable difficulty, good weather conditions being an absolute essential. V. F. W. Forneret, the superintending engineer in charge of the project, with headquarters at Ottawa, thus described this feature of the work for the SCIENTIFIC AMERICAN:

"Although, with the exception of some minor shoals at Champlain, there is practically no filling in, and although, since the commencement of the ship channel project no actual boulders have been known to be carried into the dredge channel, such conditions being possible, it has been decided that once a year the dredged and shallow channels shall be swept. A twin-screw steamer and a testing-scow make up a sweeping plant. When this is in operation the bow of the steamer fits into a 'V' shaped groove in the stern of the testing scow, which is securely fastened to the steamer by means of strong wire ropes, one on either side, so that the scow is propelled and steered by the steamer.

"A steel roller, 40 feet long by one foot in diameter and weighing about two and a half tons, is suspended under the scow to the required depth, and this sweeps the channel against the current, running a sufficient number of parallel lines to overlap each other, so as to cover the whole ground.

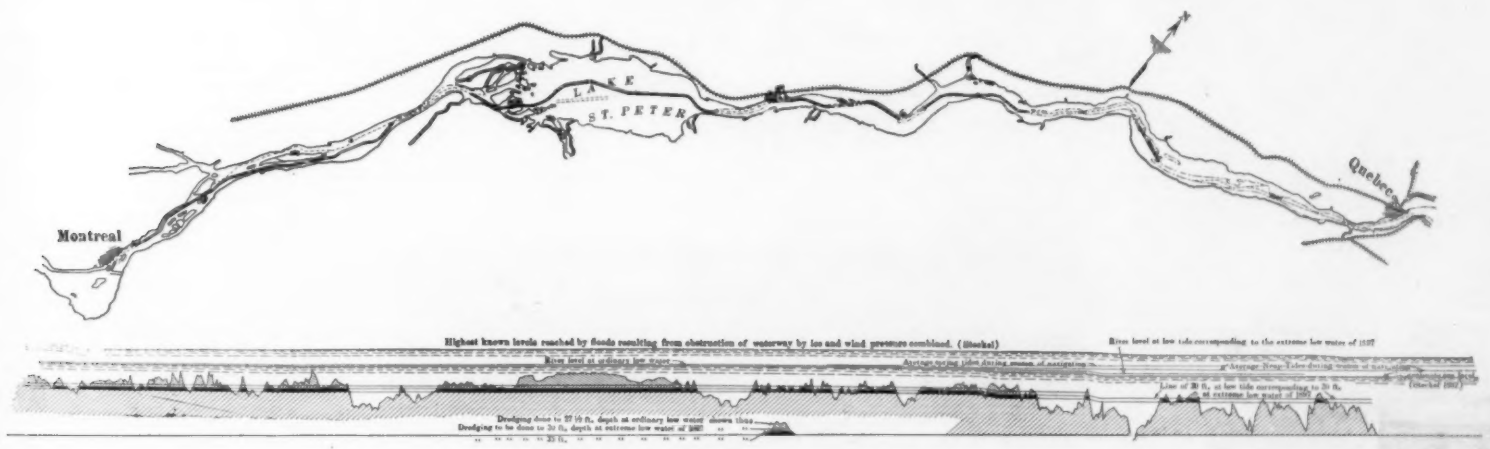
"Foggy or smoky weather, due to forest fires, will interrupt the work, because the shore marks cannot be seen for guidance in running the parallel lines. The work has to be stopped also during rough weather. As the work of testing is always done in the channel, a great deal of difficulty and interruption is caused by passing vessels.

"In tidal water the depth is constantly changing, which necessitates frequent raising and lowering of the steel bar. This is done by the aid of a winch on the scow, the steam for which is obtained from the steamer by means of a flexible steam hose.

"If an obstruction is found while testing, its position is fixed by simultaneous sextant angles taken by two engineers who stand on the bridge of the scow over the suspended roller. These angles are plotted on a chart with a station pointer, so that when the sweeping is finished in one locality, the positions of obstructions, if any, are located and shown on the chart. It is then an easy matter to have these removed by a dredge or stone-lifter, as the case may be.

"The extent of this work may be inferred from the fact that where the channel is 300 feet wide, eight lines are required to be run, and where the channel is wider, it takes from eleven to fifteen lines, and up to 22 on the curves.

"At the beginning of the season it is usual to run four lines of testing from Montreal to Batiscan through the dredged channel, and afterward the channel is tested more thoroughly. The work below Batiscan, including Cap à la Roche, where the current is strong, and the weather frequently stormy, is usually postponed until about mid-summer. Before the work below Quebec was commenced, one sweeping plant was sufficient, but at present two outfits are kept busy covering the ground required to be tested."



Map and profile showing St. Lawrence ship channel improvements.

Danger from Fire in Steel Shavings

FACTORIES and machine shops which produce large quantities of steel shavings from their lathes may take heed from a lesson recently taught at a large dynamo factory in Plainfield, N. J. In the yard of this factory the steel chips are piled up until there is a sufficient quantity to make a carload.

While a large pile of these chips was waiting for a car to take it away workmen set fire to some rubbish near by. This heated the steel and soon there was plainly visible a column of smoke issuing from the pile. A one-inch stream of water was played on the steel for several hours without having any effect other than to produce a small but lively volcano caused by steam from the water. Then the city fire department was called and after a heavy stream of water was played upon the steel it was thought to be extinguished.

However, the next morning the pile was smoking and flaming as vigorously as before and it was necessary to rake the shavings apart before the flames could be subdued. Since all steel chips from this factory are put through a centrifugal oil separator on coming from the machines, oil was not the cause of the spontaneous combustion. The fire was obviously started on account of oxidation taking place faster than the resulting heat could be conducted away from the steel which was very finely divided, and when the chips became heated from an outside source the phenomenon of combustion actually took place.

Steam Turbine Street Cars for Long Island

A COMPANY has just been organized in New York city to operate an entirely new kind of street car line at Great Neck, L. I. Although the cars will run on rails and will have every appearance of an ordinary electric car, they will be independent units operating without overhead wires, third rails or central power station.

The source of locomotion, which is the most interesting feature of this new medium of interurban travel, is a steam turbine supplied with steam from a flash boiler, the turbine operating a hydraulic speed transmission and two oil motors connected with the two axles. The flash boiler is located on one side of one platform and is heated by means of either kerosene or gas oil instead of gasoline as in the ordinary type of motor vehicle operated by steam. The turbine is located under the body of the car. It runs at a normal speed of from 3,000 to 4,000 revolutions per minute, and is geared by means of a herring-bone gear set to the hydraulic transmission which runs at about 600 revolutions per minute.

The car is of the single truck type, having only four wheels and all four of these are used for transmitting power. That is, power is transmitted from the oil pump to the two axles through two oil motors. The turbine will develop more than 25 brake horse-power, which is considered high for this type and size of engine.

Since no oil is introduced in the water which passes to the turbine as steam, it may be used over and over. In order to accomplish this the exhaust steam will be conducted through a series of covered copper pipes located on the top of the car. The steam will be condensed in these pipes and will then return to a reservoir from whence it may be introduced into the boiler when the water line falls below normal.

The car will be lighted by means of Blau gas, which will also be employed for vaporizing the fuel under the boiler. In cold weather it is proposed to heat the car by means of surplus steam from the boiler. The hydraulic transmission is the same as that used on one make of motor truck, and is employed in this case in preference to the spur gear speed change.

A Giant Aeroplane

THE St. Petersburg correspondent of the Parisian sporting journal *Aero* telegraphs to his paper that Igor Sikorsky, a student at the technical high school of St. Petersburg, has built what is probably the biggest aeroplane which has thus far appeared. Sikorsky's machine is a biplane, the upper surface of which is somewhat larger than the lower. The span of the biplane is 27 meters, and its total lifting surface is 130 square meters. The weight of the machine is 3,000 kilogrammes. The aeroplane has an enormous lifting capacity. Besides ten passengers it is designed to carry provisions, fuel for 20 hours and a miscellaneous load of 800 kilogrammes. As might be expected, the power plant is huge. Four engines, each of 100 horse-power and each driving a screw propeller are mounted in the machine. The fuselage is of wood and is shaped to form an observation cabin, a spacious pilot house with glass windows for two pilots, a rather large cabin for passengers, stores, tools, a corridor, and finally another cabin in which a couch is actually to be found for those who wish to sleep.

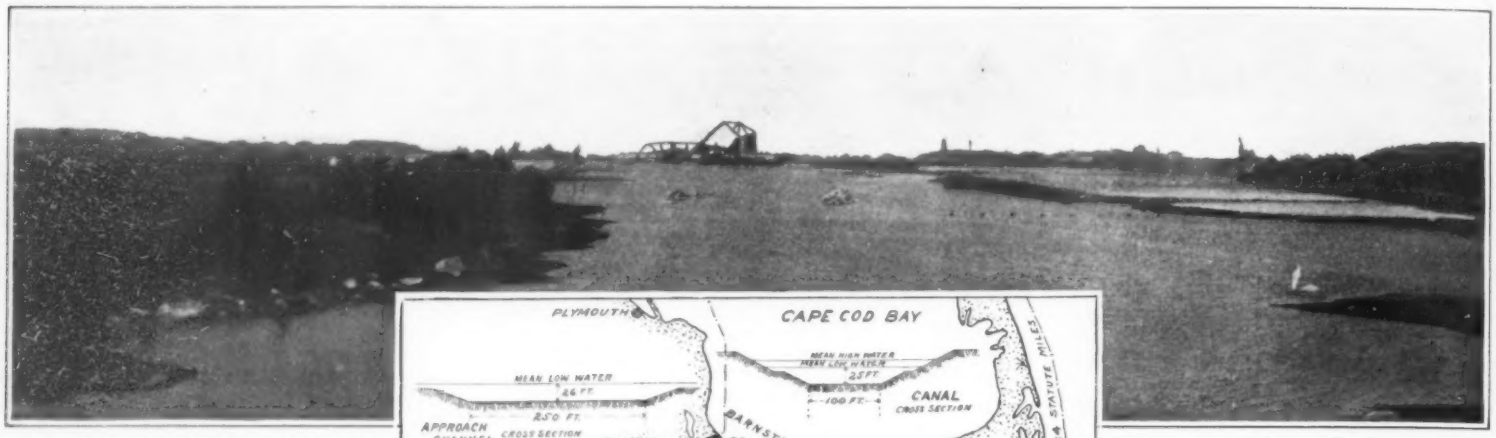
It is said that on August 2 the machine actually made a flight with seven passengers of 90 kilometers lasting not quite two hours at an altitude of 500 meters, during which the pilots took turns in the pilot house and passengers walked about as if they were in a city apartment. Experiments are also said to have been made in cutting out two motors in flight and running the machine with the remaining set of two.

Naturally these accounts of the machine's performances are received with considerable incredulity in France. To be sure, the aero-taxicab of Henri Deutsch de la Meurthe gave a good account of itself in France, but French aeroplane designers wonder how equilibrium could be maintained with passengers moving to and fro in spacious cabins. Moreover the speed obtained, less than twenty-five miles an hour, seems suspiciously low for sustentation. Further details will certainly be looked for with much interest.

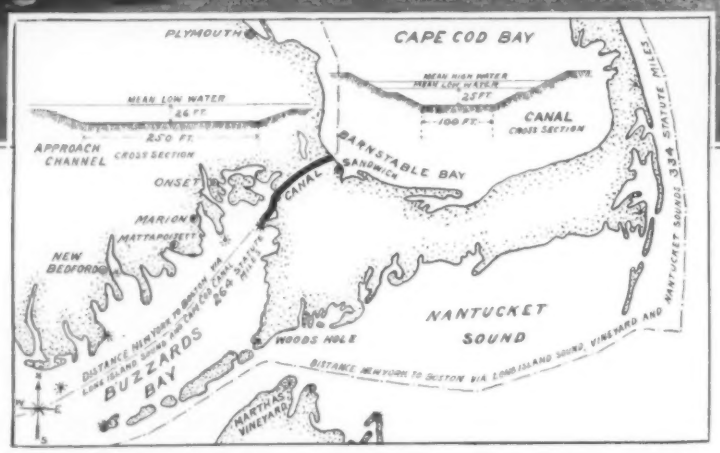
Standard Time in Eritrea.—The Italian colony of Eritrea has just adopted standard time of the meridian of 45 degrees east of Greenwich. Its time will thus be an hour in advance of that in use in Egypt, Portugese East Africa and South Africa.

The Cape Cod Canal

Saving Seventy Miles of Distance and Three Days of Time in Carrying 25,000,000 Tons of Freight



A stretch of the Cape Cod Canal, looking toward Buzzard's Bay.



Map showing the location of the Cape Cod Canal, and sections of the canal prism.

Entrance to the canal from Cape Cod Bay, showing the granite sea wall.

THE curved arm of Cape Cod with its curious fish-hook termination at Provincetown, which forms such a remarkable feature of the New England coast line, is of glacial origin. It was formed by the deposit of boulders and clay brought down from Labrador and Maine, and upon the substratum thus formed, the joint action of the waves and winds of the sea, deposited the sand, which in layers of various thicknesses and in picturesque contours, form such a pleasing feature in the landscape of Cape Cod. Inclosed and sheltered by the wide-curving promontory is Cape Cod Bay. Where Cape Cod joins the mainland, at what might be called its shoulder, there is a narrowing down of the width from shore to shore until the distance from Barnstable Bay to Buzzard's Bay is only eight miles. Buzzard's Bay lies between the mainland and the southeasterly extension of Cape Cod, which latter gives the same protection to Buzzard's Bay that Cape Cod gives to the bay named after itself. The narrow stretch joining Cape Cod to the mainland has a surface elevation of only 29 feet above high water. It is composed mainly of sand with an occasional admixture of boulders. A glance at the map will show that the shipping which passes from Boston to New York and southern ports, or *vice versa*, whether it steams or sails through Long Island Sound, or by the route outside of Long Island, at present has to pass through Nantucket Sound and around Cape Cod. Centuries of navigation have shown that the shoals of the Sound and the lee shore of Cape Cod render the route difficult and dangerous, the former because of the frequent fogs obscuring the lightships and lighthouses which are necessary to safe navigation, and the latter because of the dangers of the reefs and the lee shore of Cape Cod, upon which the Atlantic gales beat with great fury, particularly during the winter months.

The difficulties are aggravated by the fact that the larger proportion of the 25,000,000 tons of freight which annually uses this outside route is carried in sailing ships and in tows, both of which are particularly exposed to the dangers of navigation above referred to.

In view of these facts, students of the problem will see at once that, if the eight-mile strip of land between the head of

The rolling-lift railroad bridge spanning the canal near the Buzzard's Bay entrance.

This shows how a river was dammed to enable the steam shovels to work in the dry.

The majority of the excavation has been done by hydraulic dredges of 4,000-yard capacity per day.

This breakwater, 3,000 yards long, built of large granite blocks, protects the Cape Cod Bay entrance.

Buzzard's Bay and Barnstable Bay on Cod Bay were cut through and a deep-water channel formed, this shipping would not only avoid the dangers of navigation above referred to, but it would make the trip to Boston and other eastern ports with a very considerable saving of time and distance.

The agitation for the construction of Cape Cod Canal is as old as the nation itself; and we are all familiar with the story of Miles Standish, who, on September 2nd, 1627, sailed his boat up the Scusset River and met DeRessiers who in response to an urgent call, had been sent from New Amsterdam, by way of Buzzard's Bay to the rescue of the sorely oppressed colony. Later an examination and survey were ordered by the High Court of the colony. As far back as 1776, George Washington himself recognized the military value of this route; and when he found it impossible to send his troops to New York by water because of the 8-mile barrier, he said "the interior barrier should be cut in order to give greater security to navigation and against the enemy."

We have before us a chronological history of the Cape Cod Canal movement, which shows how company after company was formed to cut the canal, several acts of Congress being passed to assist in the enterprise. Finally, Mr. August Belmont, convinced that the canal could be made financially profitable, and moved not a little by the sentimental consideration that the canal would be built in the district from which his ancestors had come decided to finance the undertaking.

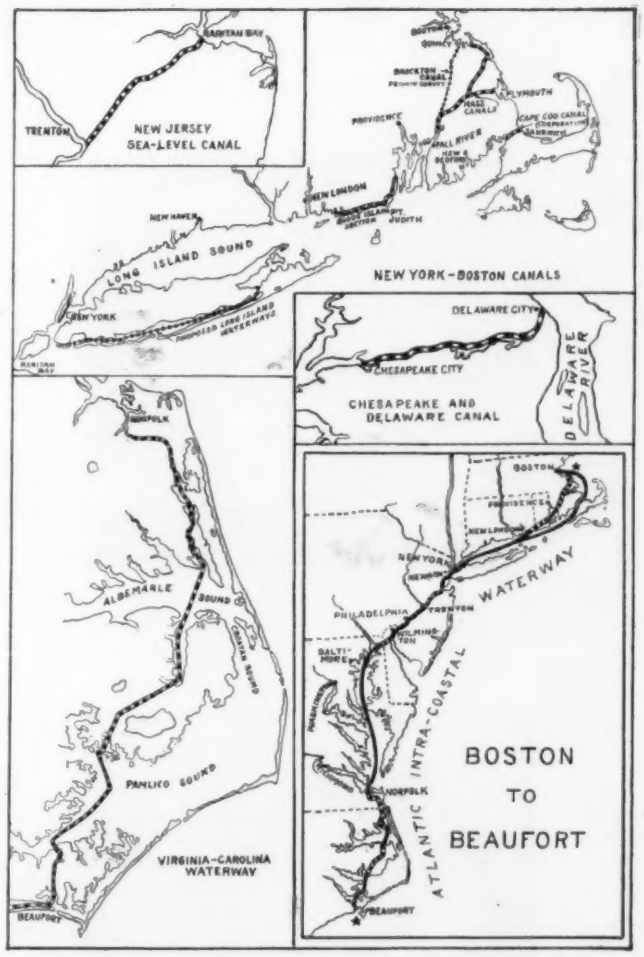
The canal is being built at sea level; its length from shore to shore is eight miles; the length from the 30-foot depth in either bay is 13 miles, and the depth throughout the canal for the present is 25 feet. The width of the bottom of the approaches in either bay is 200 feet, and the width of the bottom of the passing places in the canal is 250 and 300 feet. A breakwater 3,000 feet in length has been built for the protection of the entrance from Barnstable Bay. It should be noted that the only turn in the channel has a radius of 7,640 feet; the canal being practically straight from shore to shore.

From what we have said of the physical characteristics of the strip of land through which the Cape Cod Canal is being cut, it will readily be understood that the enterprise presents no features of serious difficulty, judged from the engineering standpoint, that cannot be mastered. There are no problems, arising from the unstable conditions of the rock or other material through which the canal is excavated, such as have added so greatly to the cost of the construction at Panama. The material is such that it will stand upon specified slopes and the banks of the finished canal are such that no erosion or washing away of the banks needs be anticipated. Most of the excavation has been done by means of hydraulic dredges. The dredging plant includes two of the largest machines of this type in the world, each of which is removing over 4,000 cubic yards per day from the canal. In one respect only have the estimates of the time of completion been upset, and this delay has been due to the unsuspected presence of a deposit of boulders, some of them of very great size, which have somewhat delayed the work and have called for special methods of excavation.

The work of the hydraulic dredges has been supplemented by steam shovels, and the contractors have got such a good grip on the work that on August 1st, 1913, there remained only 4,500,000 cubic yards of excavation to be done. During June and July of this year, material has been taken out at the rate of 400,000 cubic yards per month, and it is expected that this rate of progress will be increased until the winter necessitates some slowing down. If all goes fairly well, it is expected that the excavation will be completed by July 1st, 1914. The detail finishing up which must be done before the canal is thrown open for operation will be completed by the following November. The dredging of the four-mile approach in the navigable waters of Buzzard's Bay is done and the breakwater at the eastern end in Barnstable Bay which contains about 400,000 tons of granite is practically completed.

The importance of the Cape Cod Canal as an engineering structure is seen when we compare it with other completed canals. Although the depth for the present will be 25 feet, it is intended ultimately to dredge the prism throughout to 30 feet. The canal is greater therefore in its cross-section than the original Suez or the present Manchester Canal. The commerce of the world navigates through the former and through the Manchester Canal steamers drawing 15 feet pass one another. The clearance between bridge piers is less at Manchester than the 150 feet on the Cape Cod Canal. Furthermore, there are three passing points where the bottom is 200 feet wide; at the eastern end the width is 300 feet for nearly a mile and the approach in Buzzard's Bay has a width of 250 feet. The completed canal will be illuminated throughout on the street-lighting plan, and it will contain the various aids to navigation, these being of the most modern type. Navigation will be easy; for it is well understood abroad, where canal navigation is common, that steaming through a lighted and comparatively narrow channel, where the banks are well defined, is safer than steaming from one bright lighthouse to the next through uncertain intervening shoals. This it has been abundantly and very bitterly proved by our own coast pilots especially in passing around Pollock Rip.

The opening of the canal will offer an alternative route, the advantages of which over the old outside route are manifest. The average delay per round trip per annum for barges in tow and schooners, which now take the Vineyard route, is from three to four days; and this means a loss in money of ten cents per ton on the seven million tons of coal and lumber carried by tow and sailing craft. Although this $700,000 expense is due in part to the delays at terminals, it is a fact that the barges to-day average only one round trip per month between the Chesapeake and Massachusetts. The new canal will have sufficient depth to accommodate this traffic and all craft drawing up to 23 feet—a margin which covers all but six of the vessels at present engaged in the coastwise trade.



The system of intra-coastal canals, for which Congress is asked to make appropriations.

Regarding the advantages of navigation, we are informed by Commodore J. W. Miller that vessels run out of the southerly rains and mist region as they pass New Bedford, and that, as a rule, they carry clear weather and a smooth sea all the way to Boston; while Government statistics show that there is 50 per cent less fog at Plymouth than at Pollock Rip. Only two northeasters blowing over 40 miles an hour have occurred at Sandwich during the past 18 months. Hence the run from the breakwater at the Barnstable Bay entrance to Boston is far safer than skirting the lee shore off the Cape.

Of the military advantages of the canal it is scarcely necessary to speak. Its present draft of 25 feet will be ample for the smaller cruisers of the navy, for a large part of the auxiliary ships, and for the whole of the torpedo and submarine fleet. Should the United States Government take over the canal and increase the depth to 35 feet, it would then be of sufficient capacity to accommodate the largest battleships of the navy—in which case it would form an important link in the system of intra-coastal canals which forms the subject of another article appearing on this page.

Intra-coastal Canal System for the Atlantic Seaboard

THE present widespread movement in favor of the construction of a system of intra-coastal canals between Boston, Mass., and Beaufort, N. C., has received strong support in the form of a recommendation to Congress, made this month by Brigadier General Bixby, Chief of Engineers of the Army, in favor of the construction of the canal by the Federal Government.

The arguments in favor of putting through this great work are based upon the favorable physical conditions along the proposed route, the advantages that would be derived by our coastwise traffic, and the naval and military value of a chain of interior canals in time of war.

If a study is made of the several maps which accompany this article, showing the Atlantic Coast Line from Boston to Beaufort, it will be seen at once that its configuration is such as to invite the construction of the interconnecting canals. Cape Cod Bay, Long Island Sound, New York Bay, the Delaware River, and the long reaches of Chesapeake Bay, Albemarle Sound and Pamlico Sound, already afford several hundred miles of protected waterway, far removed from the coast line, which, if connected by canals, would afford a continuous interior route, protected alike against the shoals and heavy gales of the Atlantic, and against attacks by the ships of a hostile navy.

As the result of several years of earnest work on the part of the various commercial interests, shipping and otherwise, Congress authorized the army engineers to make surveys and estimates to determine the feasibility of the scheme, considered as an engineering proposition; the prospects of a sufficiently large amount of traffic to warrant the cost of its construction; the naval and military advantages of the canal in the event of war, and the best size and type of canal to meet all the conditions, present and future.

It should be mentioned here that the report of General Bixby concerns only a portion of the vast scheme which has been proposed for building a continuous line of canals from Boston, Mass., entirely around the Atlantic and Gulf Seaboard to the Rio Grande River. When the Boston-to-Beaufort section of the scheme has been completed, and after it has demonstrated its commercial and military value, the serious consideration of the Beaufort to Rio Grande section may come up for consideration. In any event, that will necessarily be a matter of the far future.

Great credit is to be given to the Atlantic Deeper Waterways Association, to whose organized efforts was due the provision made by the United States Congress in the River and Harbors Act of March 3rd, 1905, for a survey by the Engineers Corps of the United States Army, "for the construction of a continuous waterway, inland where practicable, from Boston, Mass. . . . to Beaufort, N. C., for the purpose of ascertaining the cost of a channel with a maximum depth of 25 feet, or such lesser depths along any section . . . as may be found to be sufficient for commercial, naval or military purposes." The present recommendations of General Bixby are based on the report of the Special Board of Five Army Engineers, which, acting under the River and Harbor Act, as mentioned above, was engaged for several years surveying the route, and presented a report thereon to Congress last year. At that time Congress appropriated funds for the purchase of the Albemarle and Chesapeake Canal and the commencement of construction of the section from Norfolk to Beaufort.

The first stretch of the original proposed 25-foot waterway is that between Boston and Narragansett Bay. Estimates made by the Army Engineers showed that a canal, 18 feet in depth, *via* Boston and Plymouth would cost $17,500,000, and an alternative canal, 25 feet in depth, *via* Taunton and Hingham, would cost $40,000,000. The Engineers also considered the advisability of purchase by the United States of the canal which is being constructed by private capital at Cape Cod. Commenting last year on the report of the Special Board, the chief engineer agreed with its finding that at the present time there appears to be no commercial necessity sufficient to justify the construction of the canal over either of these inland routes. He considered that after the other section of the intra-coastal waterways has been constructed, and the measure of relief to commerce to be afforded by the Cape Cod ship canal has been demonstrated, the question of

(Concluded on page 197.)

Normal condition of sensitive plant before being chloroformed.

When the saturated cotton wool is in position the glass shade is placed over the plant, and the whole is imbedded in hay.

Can a Plant Feel Pain?

By S. Leonard Bastin

Same specimen after chloroforming shows no sign of feeling a flame.

IT is now generally recognized that there is no essential difference between the evidences of life in the plant and in the animal; there has never yet been any satisfactory chemical distinction which clearly separates the protoplasm of the two types. One can offer no reason why the vital matter in the plant should not be capable of performing that which it is seen to accomplish in the animal. Small wonder then that Dr. Francis Darwin and others should discuss the question of plant consciousness and seek for signs of memory in the vegetable being. Certainly the so-called "sleep movements" in the bean, in connection with which some elaborate experiments have been carried out, appear to show that the plant has, to an extent the ability to remember. In this case it would appear that the failing of the light in the evening gives the signal for the drooping of the leaflets; it is found however that a bean plant which has been kept in the dark for a few days will continue to expand and close its leaflets at about the hours of sunset and sunrise. As Dr. Darwin had pointed out, we can certainly feel that the plant, or perhaps one ought to say the protoplasm in the cells, remembers that movements are carried out at certain times and these proceed even though the original stimulus is wanting.

Another very interesting problem in connection with vegetable life is embodied in the question: Can a plant feel pain? Now, although pain is a word with a definite meaning to human beings, it probably has a very wide application. An injury which would cause a man the most acute agony will bring only a small discomfort to a jelly fish; in the same way the word pain, when used in connection with a plant, can scarcely involve suffering in the sense in which the term is generally employed. Nevertheless, there is small doubt that plants do feel pain to the extent of making them show real signs of discomfort. A few months ago the writer had the opportunity of witnessing some very interesting experiments with a sensitive plant to demonstrate the extent to which the specimen might be said to feel pain.

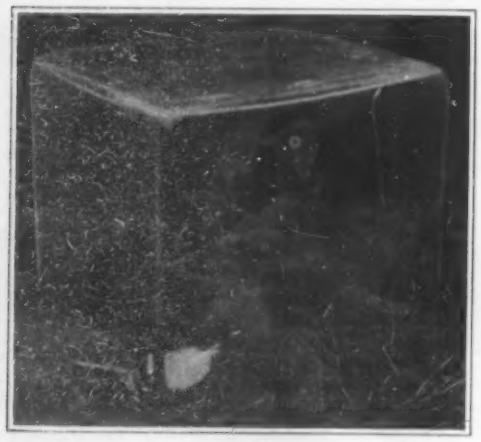
The example chosen was a young and vigorous plant of *Mimosa pudica*. Of course the degree of sensitiveness is at its height when the leaves are in the most actively growing condition. The foliage was extremely responsive to cold air and the slightest touch, closing its leaflets and dropping its stalks with great promptitude. It was decided to try the influence of a flame upon the sensitive leaf. A piece of wadding saturated with spirit was set alight, and the flame was passed rapidly under a well-developed leaf. The organ could not have received more than a whiff of hot air, yet it gave very clear signs by the movements of its leaflets that a sensation, which we may call discomfort, had been produced. In the next experiment the flame was allowed for a fraction of a second to touch the tip of one of the leaflets. The outcome was astonishing; the whole leaf shrank as if it had experienced the most acute pain.

It was now decided to administer an anæsthetic to the sensitive plant. For a long time it has been known that the mimosas are markedly affected by the vapors of chloroform and ether. The method of administering the anæsthetic is on the following lines. The pot in which the plant is growing is buried in hay or some such substance. A large glass shade is then procured, which can be placed over the specimen. A good-sized piece of wadding is well soaked with the chloroform, or whatever the anæsthetic may be; this is placed by the plant, and the whole is enveloped in the shade. After an interval of half an hour it is to be noticed that the foliage of the sensitive plant begins to droop. The leaflets gradually close together, and finally the whole plant passes into a sleeping condition, even more profound than that which normally occurs when the light begins to fall. That the sensitive plant is "unconscious" there is the very best reason for believing, seeing that it quite fails to respond to any touch. A more severe test still was the placing of the lighted wadding under one of the leaves. Here again it was evident that the ability to feel was quite in a state of suspension, just as completely as when an individual is under the influence of an anæsthetic.

There is little doubt that, before long, we shall have yet further to revise our views concerning the sensations of plants. Of course for some time it has been recognized, for instance, that vegetable tissue is capable of a response to the stimuli of light and heat. It has always been argued that plants could not feel pain or discomfort because they have no nerves. The modern physiologist asks himself the question, what are nerves? To this there is only one answer—modified and highly specialized protoplasm. We have seen that the life basis is practically the same in both plant and animal, and there is no reason why the protoplasm in the plant should not be able to act as a rudimentary nervous system. As we now know the protoplasm is not confined to the cells of the plant; tiny strands of the living matter are able to pass through the walls, and thus keep up some sort of communication throughout the entire plant. These threads of protoplasm have often been spoken of as the nerves of the plant. This they are most decidedly, not in the ordinary sense of the word. There is strong reason for believing that in some ways they carry out the functions which are usually performed by a nervous system.

Leaves of a vigorous sensitive plant spread in normal condition before the application of a flame which touched for a portion of a second the tip of one of the leaflets.

In the operation of chloroforming the sensitive plant, the liquid is poured on a piece of cotton wool, which is placed near the stalk.



The sensitive plant undergoing the chloroform treatment.

A piece of cotton-wool soaked in methylated spirit is ignited and held for a second under the leaf of the sensitive plant. The leaf at once closes.

The Heavens in September

The International Union for Solar Research and the Astronomische Gesellschaft

By Henry Norris Russell, Ph.D.

IT would probably be a very good index of the degree of anyone's acquaintance with men of science if we could know what image was called up in his mind by the mention of an international scientific congress; and therefore it will hardly be necessary to tell the readers of the SCIENTIFIC AMERICAN that such meetings are among the most enjoyable experiences—quite apart from matters of professional interest—that fall to the lot of their members.

The writer is on his way home from two such gatherings, the meeting of the International Union for Solar Research, at Bonn, and that of the Astronomische Gesellschaft, at Hamburg, immediately afterward.

The first of these was thoroughly cosmopolitan. Of the nearly ninety astronomers who attended the conference, scarcely one third were Germans. The English-speaking delegates—divided almost equally between the two sides of the Atlantic—made up another third of the number. Of the remaining thirty, twelve were Frenchmen, five Russian, and the rest represented almost every other nation of Western Europe—Italy, Austria, Holland, Belgium, Spain, Denmark, Norway, and Finland.

In a body of such varied membership the proceedings necessarily take on a polyglot nature. English, French, and German are equally the official languages of the Union, and all business notices and formal motions are announced successively in all three; while, during the discussions, speeches in one language may be answered in another, with almost bewildering rapidity.

The regular proceedings of the Solar Union differ from those of many similar societies in that no formal papers are presented, though informal accounts of work done by individual members are sometimes given. The principal work of the organization is done in the sessions of the numerous committees, which deal, for example, with such subjects as the establishment of an accurate and uniform scale of standard wave-lengths of reference lines for spectroscopic measurements with the study of the Sun's rotation by spectroscopic methods; with the measurement of the Sun's radiation of heat; with the spectra of Sun-spots; and with the classification of the spectra of the stars. These committees, which may have as many as ten or fifteen members, usually include all, or almost all, of the principal workers in their especial field, and their recommendations therefore come with an authority which usually secures for them unanimous acceptance.

The results of such committee work are rarely at all spectacular in character; but they save great expenditures of time and energy on the part of astronomical workers. For example, the committee on standard wave lengths were able to report at Bonn to the effect that the measurements of various observers in different countries gave results for the wave-lengths of the standard lines which agreed with one another, on the average, to within one part in two or three millions; so that a trustworthy and exceedingly accurate basis for future spectroscopic measurements is now in sight. On the other hand, the committee on the Solar Rotation announced that the comparison of the results obtained at different observatories showed certain small but "systematic" differences in the measured rate of the Sun's rotation—that is, it is found to be more rapid by some observers than by others, by an amount which, though very small, considerably exceeds the still smaller discordances between the results of measurements of different plates taken at the same observatory. In such a case as this, the cause of the differences must be found, and, if possible, removed. By exchanging plates already measured at one observatory, between Ottawa and Mount Wilson, and remeasuring them at the other, it was found that these differences arise, not from the instruments with which the plates are taken, but in the measurement of the small displacements of the lines shown on the plates. It seems that in spite of all precautions one observer may measure the amount of this displacement greater or less—by an almost infinitesimal quantity—than another observer does.

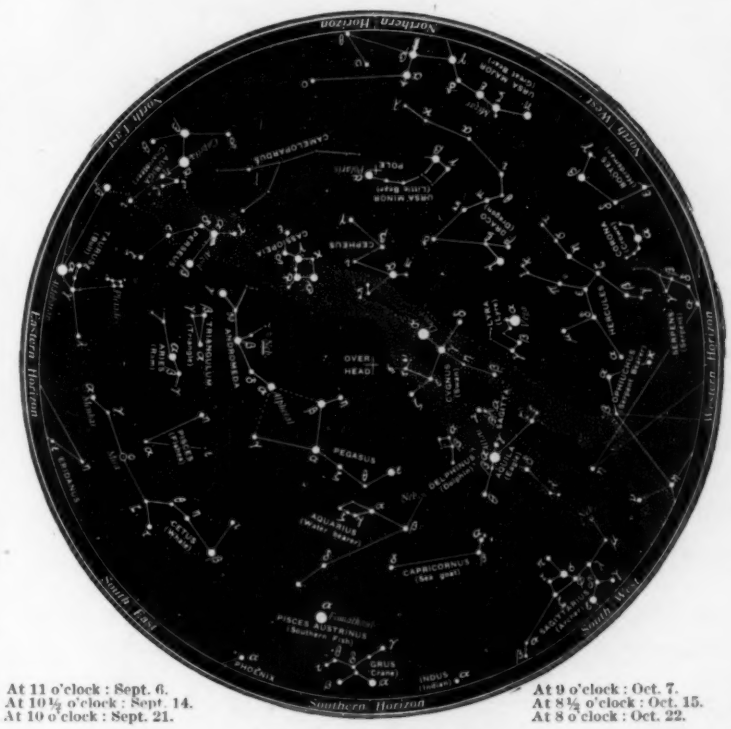
The investigations are still in progress, and there is every reason to hope that these differences—already exceedingly small—may be brought to the vanishing point by suitable methods of observation. Meanwhile, the attention of observers is to be concentrated on the detection and removal of these small errors, leaving, until the time when they have been conquered, the study of such fine points as a possible difference in the rate of rotation of the Sun when measured by means of the lines of hydrogen, of iron, or of the heavier elements. This may seem an unsatisfactory sort of report at first sight; but it is far better to know that small errors exist, and to be on the track of their cause and remedy than to be going on accumulating with great pains and labor results which are influenced by these errors; and without the general co-operation of all observers they might have remained undetected for some time longer.

The committee in the classification of stellar spectra affords still another example of the advantages of co-operation. Up to the time of its appointment, there were three or four quite different methods of describing the spectra of the stars, all more or less in use. At the first meeting of the committee, it was found to be the unanimous opinion of its members that the system of classification developed at Harvard was the best in existence, and should be adopted pending the construction of a perfected system, which must still be some years in the future. Correspondence with other astronomers brought out an almost unanimous agreement on this matter, and the recommendation of the committee was unanimously adopted by the Solar Union. In future, therefore, all astronomers, when discussing stellar spectra, will (so to speak) be talking the same language, and much confusion will be avoided.

The Astronomische Gesellschaft, though numbering upon its rolls astronomers of almost every nationality, is predominantly German in membership, and its proceedings are conducted in German. Here, too, there were committee reports, dealing largely with the results of organized work among German astronomers, but there were also many formal papers, ranging over the whole field of theoretical and practical astronomy.

As examples of the excellent work which is being done may be mentioned a paper by Dr. Rosenberg of Lübingen, who has developed a new photometer, based upon the photo-electric effect (the emission of negative electrons from a metal surface under the action of light). Using a surface of potassium *in vacuo* he has succeeded in getting results which surpass in precision those of all previous instruments, even the selenium photometer with which Prof. Stebbins has had such success.

Again, Prof. Hayn gave an account of a study of the shape of the Moon's limb, in which, by measuring upon a long series of lunar photographs, the distances of many points of the edge from the center he has been able to construct a contour map of that region of the Moon's surface which forms its apparent edge under the varying angles of libration. This is not simply of interest in itself, but will be of great value in the reduction of lunar observations. Suppose, for example, that an observer watches the occultation of a star behind the Moon, and records the exact instant of its disappearance. Such observations, if the Moon were perfectly round, would give us a very accurate determination of its position in the sky at the moment of observation. The irregularities of her surface, however, introduce serious errors. If the star happens to go behind a mountain on the Moon's edge, it will obviously disappear sooner than if the surface were leveled off; if it strikes a deep valley, it will remain in sight longer. By reference to Dr. Hayn's map the computer can determine whether either of these things happened, and allow for the resulting error, so obtaining much more accurate results. The scientific side of these meetings—important and interesting as it was—can hardly occupy a larger place in the memory of the delegates than the personal element. Public and private hospitality was of the most generous and delightful nature. Three great German cities—Bour, Cologne, and Hamburg—entertained the astronomers right royally; and our scientific hosts at the various observatories left us under an equal debt of kindness. And these festivities had more of meaning in them than the ordinary public banquet. One note was heard again and again in the addresses of welcome, and in the responses (which, taken together, represented six or seven different languages), that of international good-will. In such a gathering, where personal friendships add to the common bond of scientific interest, differences of nation, race, and creed drop out of sight; and we may hope that they contribute their share, not only to the advancement of human knowledge, but to that of human brotherhood as well.



At 11 o'clock : Sept. 6.
At 10½ o'clock : Sept. 14.
At 10 o'clock : Sept. 21.

At 9 o'clock : Oct. 7.
At 8½ o'clock : Oct. 15.
At 8 o'clock : Oct. 22.

At 9½ o'clock : September 29.

NIGHT SKY: SEPTEMBER AND OCTOBER.

The Heavens.

A glance at our map shows us what we may see in the evening sky. The great square of Pegasus is high in the southeast. Below it is the large but faint constellation Pisces, and the still larger, but more conspicuous form of Cetus. To the right, low in the southern sky, is Fomalhaut, which, though distinctly fainter than the standard first-magnitude star, is very conspicuous on account of its isolation.

Aquarius, above it, and Capricornus, to the westward, are dull constellations. The far southern group of the Crane (Grus), which may now be seen below Fomalhaut on a clear night, would be conspicuous if viewed from a lower latitude.

In the southwest, along the Milky Way, is a far finer region, Sagittarius (now brightened by the presence of Jupiter) is low on the horizon. Above it, all the way to Aquila, extend the great star-clouds of the finest part of the Galaxy Way. Still higher, west of the zenith, are Cygnus and Lyra. Hercules and Corona Borealis are below the latter, and Ophiuchus and Boötes are setting. The Great Bear is low on the northern horizon, with the Dragon and the Little Bear above it. Auriga is rising in the northeast, and Perseus and Auriga are above him in the Milky Way. Andromeda and Aries are high in the east, and Taurus is rising below them.

The Planets.

Mercury is morning star until his conjunction with the Sun on the 16th, and evening star afterward; but he is practically invisible except at the very beginning of the month, when he can be seen, just before dawn, close to the bright star Regulus, which he greatly exceeds in brilliancy. Venus is also morning star, in Cancer and Leo, rising about 2:20 A. M. on the 1st and 3:20 on the 30th. On the morning of the 25th she is very near Regulus, only about fifteen minutes from him, and the star, bright as it is, will be almost lost to view in the planet's rays.

Mars too is nominally a morning star until he comes into quadrature with the Sun on October 2nd; but being very far north, in Gemini, he rises at 11:20 P. M. at

(Concluded on page 194.)

Chalmers— 1

$2175

Fully Equipped

The Master Motor of Them All

What other makers are still striving for we give you in the New Chalmers "Six."

To the best features of the costliest cars we have added these crowning triumphs:

Silence at all speeds; silence that lasts.

Sustained power; even after years of use.

No vibration; comfort and long life.

Extreme flexibility, without intricate gearing.

These features mean far more than the luxury they bring. They mean minimum wear—no waste of power. A car that lacks them, may cost you less to buy—but it will cost you more to keep.

When once you know the years of extra service these features add, you'll wonder how we give them at the price, $2175.

Go ride in this car. Let it tell its own story in deeds. It can neither over-rate its virtues nor hide its defects. It must tell the truth—nothing else.

Silent At All Speeds

Many cars that are quiet at ten miles an hour, kick up a lot of noise at thirty.

Let us see what the New Chalmers "Six" will do. Watch the speedometer; 30—40—50 miles an hour and not a murmur from cams nor valves.

We have discarded the common type of noisy little wedge-like cams so widely used. They knock the valves open with a blow and close them with a snap. The big oval cams of this motor push open the valves and slide them shut with the smoothness of velvet.

So this car runs with the silence of a spectre at fifty miles an hour or at five Such silence is not generally found in a motor car.

What Silence Tells You

The silence of the Chalmers "Six" means more than the mere luxury of quiet. Listen to its story as we skim along, noiseless as silk from a silent loom.

It tells you that your motor is working with the perfection of a watch—with but minimum wear; that it will perform as well after long use as the day you bought it.

And this silence continues for years. 30,000 miles of hard road service, equal to three years of average use, left this motor as good as when it started.

Makers have long been trying to secure silence that lasts. We solved the problem first.

$80,000 Extra Cost to Us—An Enormous Saving For You

This motor, like the trained athlete, grows better by action.

The cast iron and nickel steel valves in general use today soon begin to show wear. They are soon pitted and warped by the blistering heat of the cylinders. They fail to shut tight; they waste power; they have to be reground often.

Our valves of Tungsten steel cost us $80,000 extra per year. But Tungsten steel is not affected by the cylinder heat. So there's no warping—no leaking—no power wasted. They almost never need regrinding.

This means an enormous saving of power to you. It means least wear—minimum depreciation. Think of the years of extra service this master motor will give you.

Power—Supple as a Fencer's Wrist

The power of our New "Six" is so flexible that you can throttle it down on "high" to a creeping gait in the crowd; then away swift as a swallow, mounting quickly to twenty, thirty, forty miles an hour without stress or effort.

SALIENT FEATURES OF THE

Six-cylinder motor, T-head type, 4x5½ —40-65 h. p. All moving parts enclosed. Pressure and splash oiling system. Cork insert clutch.

Bosch Magneto.

Electric Starter—Entz System, built in Chalmers shops.

Non-stallable Motor.

Full Electric lights.

132-inch wheel base.

Molded oval fenders.

This is due to our big, roomy valves; they open 40% wider and shut tighter than common. This gives freer passage to the gases. The wondrous flexibility of this motor is amazing. You'll find you can do nearly everything on "high." It does away with gear shifting almost entirely. With this "Six" any supplementary gear mechanism would be useless. The motor itself gives a suppleness of power unknown even in costlier cars.

A Non-stallable Motor

This motor will never go dead in the crowded city traffic. The electric starter won't let it.

Even if the driver should cut off the gas accidentally, the electric starter, which is always on duty, keeps the motor running—won't let it stop.

It prevents stalling under sudden overload. This is the greatest feature of safety and convenience put on a car in the past five years.

Steep hills, muddy or sandy roads never worry the motor of the New Chalmers "Six."

An Electric Starter That Never Quits

The simplest and surest starter ever made. A little motor spins the engine to start it. Then it reverses itself, becomes a generator and stores up power in the battery for electric lighting and future starting purposes.

Alabama
Birmingham—Birmingham Motor Co.
Montgomery—Stuart & Berridge

Arizona
Phoenix—Phoenix Auto Co.

California
Los Angeles—West'n Motor Car Co.
San Francisco—Pioneer Auto Co.

Colorado
Colorado Springs—Beecher Motor Co.
Denver—McDuffee Motor Co.

Connecticut
Middletown—F. L. Cauklins Gar. Co.
New Haven—W. A. Maynard Co.
Torrington—E. A. Perkins Elec. Co.

District of Columbia
Washington—Zell Motor Car Co.

Georgia
Atlanta—John M. Smith

Illinois
Bloomington—C. U. Williams & Co.
Chicago—Chalmers Motor Co. of Ill.
Decatur—Decatur Auto Garage
Danville—E. B. Collins
Lawrenceville—Lawrenceville Auto Co
Galesburg—Judd Seacord & Son.
Monmouth—Weir Motor Co.
Rock Island—Benj. C. Barth
Quincy—T. C. Nichols Motor Car Co.
Springfield—O. W. Hatcher Co.

Indiana
Ft. Wayne—Randall Motor Car Co.
Indianapolis—Conduitt Auto Co.
Mount Vernon—Kock-Gonnerman Co
Mishawaka—George C. Clark
Terre Haute—Cole Auto Co.
Lafayette—Fafayette Auto Co.

Iowa
Burlington—Sheagren & Hunt
Cedar Rapids—Lattner Bros.
Des Moines—Iowa Auto & Sup. Co.
Davenport—Mason's Carriage W'ks
Dubuque—Peter Even & Sons
Ft. Dodge—Ft. Dodge Auto Co.
Sioux City—H. A. Wetmore
Waterloo—Bryant Motor Car Co.

Kansas
Hutchinson—Taylor Motor Co.
Topeka—Imes-Clark Motor Co.
Wichita—Wichita Automobile Co.

Kentucky
Catlettsburg—C. C. Magann
Lexington—C. M. Marshall Co.
Louisville—Hite D. Bowman

Louisiana
New Orleans—Chalmers Mot'r Co.of La.
Shreveport—Bernstein-Smith Auto Co.

Maine
Portland—Maine Motor Car Co.

Maryland
Baltimore—Zell Motor Car Co.
Cumberland—Citizens' Garage

Massachusetts
Boston—Whitten-Gilmore Co.
Lynn—C. E. Whitten
Pittsfield—Pittsfield Auto Garage
Springfield—Norcross-Cameron Co.
Worcester—Frank H. Kenney

Michigan
Benton Harbor—W. H. Hearn
Calumet—Michigan Auto Co.
Detroit—Neumann-Lane Co.
Grand Rapids—John Vlasblom
Kalamazoo—Globe Gar. & Mfg. Co.
Ludington—Donald MacVichie
Muskegon—Chas. J. Durheim

Minnesota
Duluth—Mutual Auto Co.
Minneapolis—Barclay Auto Co.
St. Paul—Smith & Heberle

Mississippi
Brock Haven—Albert A. Lilly
Greenwood—E. M. Purcell
Vicksburg—Mississippi Electric Co.

Missouri
Jefferson City—T. G. Burkhardt
Kansas City—
Chalmers Motor Co. of Missouri
Kirksville—Chas. S. Sands
St. Louis—Park Automobile Co.
St. Joseph—Wyeo Car Co.
Webb City—M. H. Wood and Co.

Montana
Bozeman—Nelson & McKay

Nebraska
Hastings—Stitt Motor Car Co.
North Platte—Miner Hinman
Omaha—Stewart-Tooser Motor Co.

New Hampshire
Keene—O. L. Blake & Co.
Nashua—Pollard Auto Co.

Chalmers Representati

There is a Chalmers distrib you. In addition to the dea there are more than 500 who work through these di

New Jersey
Lakewood—Lakew'd Gar. & Mch. Co.
Newark—Paddock-Zusi M. C. Co.
New Brunswick—Jno. Weigel
Trenton—John L. Brock

New York
Albany—Albany Garage Company
Buffalo—Mason B. Hatch, Inc.
Binghamton—June Auto Co.
Elmira—La France Garage Co.
Ithaca—Lang Engine & Garage Co.
Jamestown—Peterman Motor Sales Co.
Malone—H. D. Thompson & Co.

1914 The New "Six"

$2175
Fully Equipped

OF THE NEW CHALMERS "SIX"

- **Gasoline Tank and tire carrier on rear**—clean running boards.
- **Left drive and centre control**—enter from either side.
- **36x4½-inch tires and Continental Demountable rims. Four forward speed transmission.**
- **Underslung rear springs;** main leaf of vanadium steel.
- **Tapered bonnet and stream line, bell backed body.**
- **Chalmers patented doors.**

And it does it without attention—without aid of automatic devices. You simply throw on the switch at starting and forget it. This starting and lighting system is built entirely in the Chalmers shops.

That Vibration Jinx

After a long ride you are often tired and you don't know why. It's the vibration jinx in the power plant. It means the moving parts are too heavy or a fraction out of balance.

We overcome vibration in this way: We have found a way to forge our connecting rods so they are stronger and yet 40% lighter than the average.

We give the motor an extra long stroke and so reduce the number of strokes. All moving parts are balanced on a delicate scale; even the clutch and the timing gears are balanced with the rest of the motor. Thus we have made the vibration of the New "Six" imperceptible. The luxury of its motion soothes like a lullaby.

This smoothness of the "Six" saves wear on the car as well as on the passengers. The interval between explosions of any "four" makes a gap in the power stream. There's no escape from the vibration that this gap in the power stream of the "four" produces. The explosions of the "Six" give an unbroken stream of power. It gives smoothness and economy that no "four" can equal. It adds years to the life of the car.

Snap Your Fingers at Poor Gasoline

With our New "Six" you can use the low grades of gasoline, because it gets the gas hotter than common.

We heat the gas in three ways to make sure; by two jackets of hot water and one of hot air. Every atom of gasoline is turned into power. This means an enormous saving in a season's fuel bill.

Stop Craning Your Neck

In driving this car you sit where you should sit—on the left. You can see close-passing cars without effort. An immense advantage in congested traffic.

The center control levers have been pushed forward so you can tuck a robe around you. It leaves both sides clear—you can enter from either one—and always from the curb. The emergency brake lever is located to the left of the gear lever. So there's no chance of your seat-mate getting in the way at a critical moment.

This has proved the most successful center control yet invented.

Four Eyes In Two

Search lights are forbidden in some cities and in many others they soon will be.

So for city driving we have set two auxiliary electric lamps of moderate power in the top of the big, powerful search lights needed for country driving.

This arrangement does away with side lights entirely. All lights are operated from the dash.

The Beauty of the Car

As we make the motor better we make the car handsomer.

We spent $75,000 in new equipment to give you its long oval fenders; not alone for the added beauty, but for their utility as well.

They curve over the wheels so no mud can ever reach you. They are pressed from a single piece of steel; no joints nor mouldings to rattle or collect dust.

Bodies are big and bell shaped. Plenty of room to stretch your legs in either seat. Doors are wider than usual with concealed hinges. They fit so snugly that all mouldings are dispensed with.

Extra tires are carried in the rear leaving the running boards clean as a quarter-deck. Everything about it tends to give the New Chalmers "Six" the flowing, stream-line effect of a graceful steam yacht.

Chalmers Motor Company.
Detroit, Mich.

No Need to Pay More; Unwise to Pay Less

It is impossible to get more real value than we give you in the New Chalmers "Six." The wonder is that we can do it at the price.

But this car is the product of a $7,000,000 factory, where economy of production has been perfected as never before; where enormous output reduces cost to a minimum.

Our company is more than a mere corporation. It is an organization; made up of men spurred by one common ambition to produce a car as near perfection as man can make it.

In the New "Six" you get features that mean your car will run year after year as smoothly and silently as the day you bought it; features that keep operating costs down to the minimum.

To buy a car that lacks these features—even though the first cost be less—is short sighted. To pay more is an extravagance in our opinion.

Let the Car Tell Its Story in Deeds

We want you to take a ride in the New Chalmers "Six"—a ride that will make you prefer this car above all others.

This ride isn't just a ride. It is the Chalmers Standard Road Test,—a part of our regular sales plan. It is used by all our dealers to show what the Chalmers will do under all conditions of service; how it meets emergencies—overcomes obstacles. It will prove to you in deeds what we have told you in words. Let our local dealer take you on such a ride.

Roadster . . .	**$2175**	**Six Passenger . .**	**$2275**
Four Passenger .	**2175**	**Coupé . . . . .**	**2850**
Five Passenger .	**2175**	**Limousine . . .**	**3600**

All bodies interchangeable.
Prices include full equipment and are f. o. b. Detroit

Send for the Facts

Send us this coupon and we will mail you one of the most interesting and valuable books ever written about motor cars. It tells by pictures and words facts that every one should know. Mail the coupon now.

Send me literature explaining why the New Chalmers "Six" is the Master Motor of them all.

Name_____

Street_____

City_____ State_____

S. A.

presentatives Everywhere

ers distributor or dealer near to the distributors listed here, han 500 Chalmers dealers h these direct representatives

New York—*Continued*
New York—Carl H. Page & Co.
Olean—F. W. Forness, Jr.
Poughkeepsie—J. Van Benschoten
Rochester—Mandery Motor Car Co.
Syracuse—Chalmers-Syracuse Co.
Schenectady—B. A. Burtiss
Utica—Wescott Garage Company

North Carolina
Asheville—Asheville Auto Company
Charlotte—O. L. Barringer Co.
Raleigh—Raleigh Motor & Mch. Co.
Windsor—Windsor Hardware Co.

North Dakota
Fargo—Fargo Auto & Supply Co.
Grand Forks—Moore Auto Co.
Jamestown—Northern Auto Co.
Minot—Minot Auto Co.

Ohio
Alliance—Al. Shem
Ashtabula—High-Level Auto Co.
Akron—Akron Auto Garage
Columbus—Broad-Oak Auto Co.
Cincinnati—Fisher Auto & Ser. Co.
Cleveland—Weaver Twelvetree Co.
Dayton—Borchers Car & Auto Co.
Findlay—Collingwood & Edwards
Lima—W. E. Rudy
Mansfield—Ideal Gar. & Supply Co.
Portsmouth—W. J. Friel
Steubenville—Collins Bros.
Toledo—Union Supply Co.
Washington C. H.—
P. F. Ortman Motor Car Co.
Youngstown—Standard Auto Sales Co.

Oklahoma
Oklahoma City—
Oklahoma Chalmers Co.
Muskogee—Roberts Motor Car Co.
Tulsa—Tulsa Motor Car Co.

Oregon
Portland—H. L. Keats Auto Co.

Pennsylvania
Harrisburg—Keystone Motor Car Co.
Meadville—Park Ave. Garage.
Oil City—Garvey & Malerich
Pittsburgh—Pittsburgh-Chalmers Co.
Philadelphia—
Chalmers Motor Co. of Phila.
Ridgway—Paul T. Arnold
Scranton—Lackawanna Auto Co.
Sharon—Hoffman Motor Car Co.
Uniontown—Keystone Auto Co.
Wilkes-Barre—Diamond City Motor Co.

Rhode Island
Providence—Davis Auto Co.

South Carolina
Columbia—Gibbes Machinery Co.

South Dakota
Aberdeen—Blain Auto Co.
Redfield—Blain Auto Co.
Sioux Falls—Power City Auto Co.

Tennessee
Chattanooga—Chatta. Motor Car Co.
Memphis—Tri-State Chalmers Co.
Nashville—Tennessee Auto Co.

Texas
Dallas—The Halff Co.
El Paso—Chalmers M. Co. of El Paso
Houston—Hawkins-Halff Co.
San Antonio—G. A. C. Halff
Austin—Thomson-Halff Co.
Waco—Willis-Halff Co.

Utah
Salt Lake City and Ogden—
Cheesman Auto Co.

Vermont
Burlington—Van Ness Garage.

Virginia
Charlottesville—Irving-Way-Hill Co.
Fredericksburg—W. H. Richards, Jr.
Lynchburg—Piedmont Motor Co.
Norfolk—Chalmers M. Car Co. of Va.
Richmond—Eastern Motor Sales Co.
Roanoke—The Model Garage
Staunton—Beverly Garage
Suffolk—Elliott Motor Co.

Washington
Spokane—Hodgins-Fosdick Motor Co.
Seattle—Olympic Motor Car Co.
Tacoma—Union Motor Co.

West Virginia
Elkins—E. O. Fling & Co.
Parkersburg—Logan Car and Auto Co.

West Virginia—*Continued*
Wheeling—Woodsdale Motor Car Co.
Charleston-Kanawha Garage

Wisconsin
Eau Claire—Hobbs Supply Co.
Green Bay—Lucia Bros. Motor Car Co.
Madison—Hokanson Auto Co.
Milwaukee—Hoppe Hatter Motor Co.
Wausau—L. H. Hall Auto Co.

Canada
Calgary—Western Motors, Ltd.
Edmonton, Alta.—The Bellamy Co.
London—J. C. Boomer
Montreal—Comet Motor Co., Ltd.
Regina—J. L. McLaren
Saskatoon, Sask.—J. O. McLaren
St. John, N. B.—F. J. Harding
Sydney, N. S.—Shaw & Mason, Ltd.
Toronto—Auto and Supply Co., Ltd.
Vancouver—H. M. Welch Auto Co.
Victoria—Wood Motor Co.
Winnipeg—Jos. Maw & Co., Ltd.

Launching an Aeroplane from a Cable

AN official test was made, last month, by M. Louis Blériot, of a new launching apparatus, particularly adapted for use on board ships and on land where the surface is too rough for the aeroplane to acquire the speed necessary to raise it off the ground. Two pairs of poles were erected 250 feet apart, the members of each pair being 65 feet apart and spanned by stout cables. Stretched between these end spans was a main cable which formed the launching track. On the flying machine a wooden frame was supported which terminated at its upper end in a pair of outwardly curving horns. At the juncture of these horns a latch was provided which could be opened by pulling a cord that ran to the operator's seat. M. Blériot skilfully maneuvered the machine so that the horns would straddle the cable and the latter would be caught under the latch. If he wished to launch the machine he set the propeller going and let it run along the cable until it had acquired sufficient speed, when he pulled the latch and depressed the horizontal rudder sufficiently to pass under the end span of the cable. The apparatus calls for some very nice maneuvering on the part of the operator which might be absolutely impossible of achievement in gusty weather, particularly if the wind did not happen to blow along the line of the cable.

Where One Old Car Has Gone

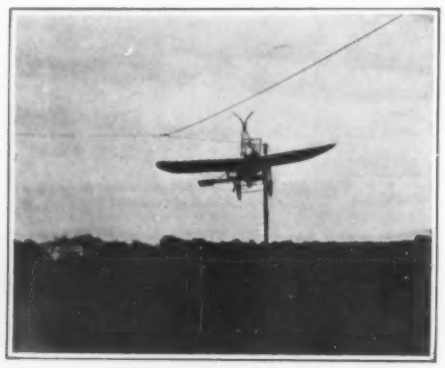
"WHERE do all the old cars go?" is a question that is asked continually, and there are very few persons who can even approximate the answer with any degree of satisfaction either to themselves or to others. But it is certain where at least one of them has gone for it is shown in all its new glory as a sedate lawn mower, by the accompanying picture. The reason for its fall from aristocratic to plebian work is because its owner has a really tremendous lawn to keep in trim; he is head gardener for a large golf club and as every one knows putting greens must be kept "just so." There was an antiquated two-cylinder automobile on the premises that long had ceased to be of any practical value for pleasure purposes and the gardener conceived the bright idea of making it "die in the harness," so to speak. So with the help of some steel strips and some chains he attached no less than three lawn mowers to it—originally they were drawn by horses. The steering gear is intact except that the place of the front wheels is taken by a heavy roller; two rollers take the place of the driving wheels.

Bridge Erection Without Scaffold

THERE was a remarkable demonstration of bridge construction at Hessenwinkel, near Berlin, recently. The bridge in question was an iron road bridge of 150-foot span over the Müggelspree which at that point makes a sharp bend and has rather violent currents. As a stationary scaffold would have interfered with the very heavy local navigation, the contractors, Messrs. Breest & Company of Berlin, suggested erecting the whole bridge on land, and eventually moving it across the river by means of an ordinary barge of 200 tons capacity. The arrangements made to this effect comprised a stationary wooden trestle on each bank of the river and a guide path of double T girders and rails connected therewith. Having been placed on small iron two-wheel trucks, the bridge was on these guide paths moved out sufficiently for one end to rest on the wooden trestle installed on the barge. The barge, which had been weighted with sand, was then slowly unloaded and rose, lifting the bridge off the forward trucks. Then, resting on two trucks at the rear end, the bridge was moved on by means of winches installed on the opposite bank (operated by four men) until its point reached the trestle on this bank. After supporting this point again on two trucks, the last advance over the abutment stones was quickly made.

The floating of the bridge across the river occupied 11 minutes, during which time navigation had to be suspended. The net weight of the bridge totaled about 80 tons.

The launching horns.



About to seize the cable.

Blériot's aeroplane launching apparatus.

Using an old automobile to haul lawn mowers.

Moving the bridge across the river on a barge.

Electric car operated by the contact system.

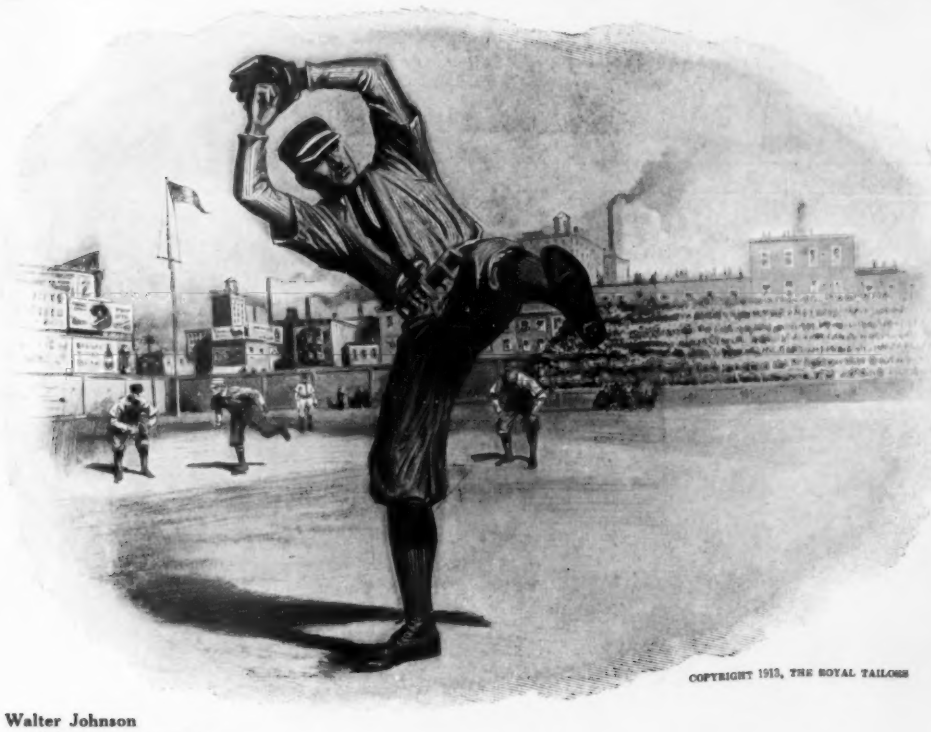
Resonance in Wood

IT has long been known how indispensable the coniferous woods are for certain technical and structural purposes, as a result of their uniformity in structure, ease with which they can be worked, and their capacity to return to their original form when subjected to a strain. Upon what structural characters these qualities are dependent is not generally known, and even science has not taught us very many useful facts about them. Amati, Stradivari, and others knew by experiment that the wood of spruce from the Alps possessed the quality of resonance to a much greater degree than other woods when made into a violin. The reason for this should be sought in the structure of the wood.

Coniferous and broadleaf trees produce wood of widely different physical properties, which are determined largely by the structure of the wood. Coniferous woods are composed largely of vertically elongated, closely packed wood fibers technically known as tracheids, and those of broadleaf trees are made up of wood fibers, wood-parenchyma fibers, and vessels, all of which vary in size and thickness of wall. In the former the wood is simple in structure and in the latter it is very complex. Both groups of woods have horizontal rows of cells which extend from the pith or center of the stem to the bark. These are called pith rays. In coniferous woods these rays are usually only one row of cells wide, while in broadleaf trees they are often much wider. For instance, in the oak woods they are very conspicuous on a smooth transverse surface and often form nearly 30 per cent of the wood mass. The presence of these relatively large rays and pores or vessels in the wood of broadleaf trees naturally disturbs the regular arrangement of perpendicular elements, which is not the case in coniferous woods. The uniform structure combined with the great strength and elasticity of many coniferous woods renders them suitable for producing sound waves of different intensities. Of all our native woods, the one that possesses this property of resonance more than any other is the spruce of the Northeast. This quality is to be found more especially in woods with perfectly straight fibers and narrow annual rings of growth of equal width. Defects such as knots, cross-grain, resin pockets, minute season checks, render the wood unfit for sounding boards. Very light woods with uniform structure combined with great strength and elasticity are invariably selected for this purpose, and the spruces fill this requirement better than any other known wood.

Contact System of Electric Haulage

IN a busy steel plant at Burnham, Pa., an electric haulage system is being successfully operated day and night under the most trying conditions. This haulage system uses neither trolley nor third rail, but a surface contact made underneath the locomotive. As shown in the accompanying photograph the locomotive carries a contact rail, adapted to bear against boxes placed between the tracks. These boxes are so spaced that at least one of them is always in contact with the contact rail. The contact boxes are dead, except when depressed by the contact rail, so that the system is absolutely safe at all times. The plant where this system is in operation is so crowded with furnaces, machinery and iron rolls that the tracks must be constantly crossed. Hot bars of iron from the furnaces on one side of the track are being continually transferred to rolls on the other side. From the rolls the bars of white hot iron are passed back over the track again, so that the system receives two hot baths from every piece of iron that comes out of the furnace, and it becomes so hot that it is necessary, from time to time, to flood the roadbed with water. In another part of the mill enormous shears are in operation cutting car axles into the proper length for use in the furnaces. These shears are so near the tracks that the heavy axles are frequently dropped on the rails and piled up on boxes; yet the system is not harmed in any way. The absence of poles and overhead wires makes this type of electrical haulage particularly useful in a plant of this kind.



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Walter Johnson
"Washington Senator" in his Working Clothes

Walter Johnson—
The Royal Tailored Man!

"It's funny what a difference a few Clothes Make!"

If you want to fully realize the tremendous influence that clothes have on a man's looks, just compare your favorite ball player on and off the Ball field. The transformation is simply bewildering!

No matter how bemauled and inelegant your star may appear in ball togs—he's a model of good taste and good style when in dress clothes. The contrast between Muggsy McGraw at the Polo grounds and John McGraw on Broadway is the contrast between the disheveled and the genteel.

Ball players as a class, are among the best dressers in America. They know that in Life's game good clothes are a mighty important factor. A man can't maintain a high batting average in the world's esteem if he wears the uniform of failure. That's why the wisest and best known stars like Ty Cobb, Walter Johnson and Ed Walsh have "That Royal Tailored Look" in private life.

SIX BIG FEATURES of ROYAL TAILOR CLOTHES
•Made To Your Measure
•All Pure Wool
•A Legal Guarantee With Each Garment
•100% Process Shrunk
•Cost No More Than Ready Made
•Six Day Schedule Deliveries

We pay $1 A Day For every Day of Delay When A Royal Garment isn't Finished on time

The beauty of the Royal Tailored Service is, that it brings the best made-to-measure clothes to every man everywhere, at a comfortable price.

Made-to-Order—Absolutely

Mind you, we said "made-TO-ORDER" clothes—for every Royal Suit is made to individual measure—and individual specification.

At the Royal dealer's store you can now pick out your Fall woolen from half a thousand of the latest and richest weaves; exclusive Royal designs. And the dealer will take your measurements for us—by a system that blue prints your figure for our cutters and tailors.

Made-to-measure service, solely.

No money can buy better tailor-made clothes than Royal clothes. Better clothes are simply not "makable!" Yet, you can get your Royal Tailored Suit or Overcoat to order for Fall at

$16, $17, $20,
$25, $30, $35,

Insist on the Genuine!—We will prosecute any use of the Royal name and trade-mark on clothes not made by us. But to be sure you get real Royal Tailoring, look for the Royal tiger head on all woolens shown.

(Special to Foremost Clothiers:—
If your store—the best in your town—is without a Royal Corner, it is an exception to a fast growing rule. Write us for Special Proposition to First Rate Clothiers.)

This Guarantee comes buttoned onto the Garment

"Get that Royal Tailored Look"

The Royal Tailors

"The Clothes That Real Men Wear"

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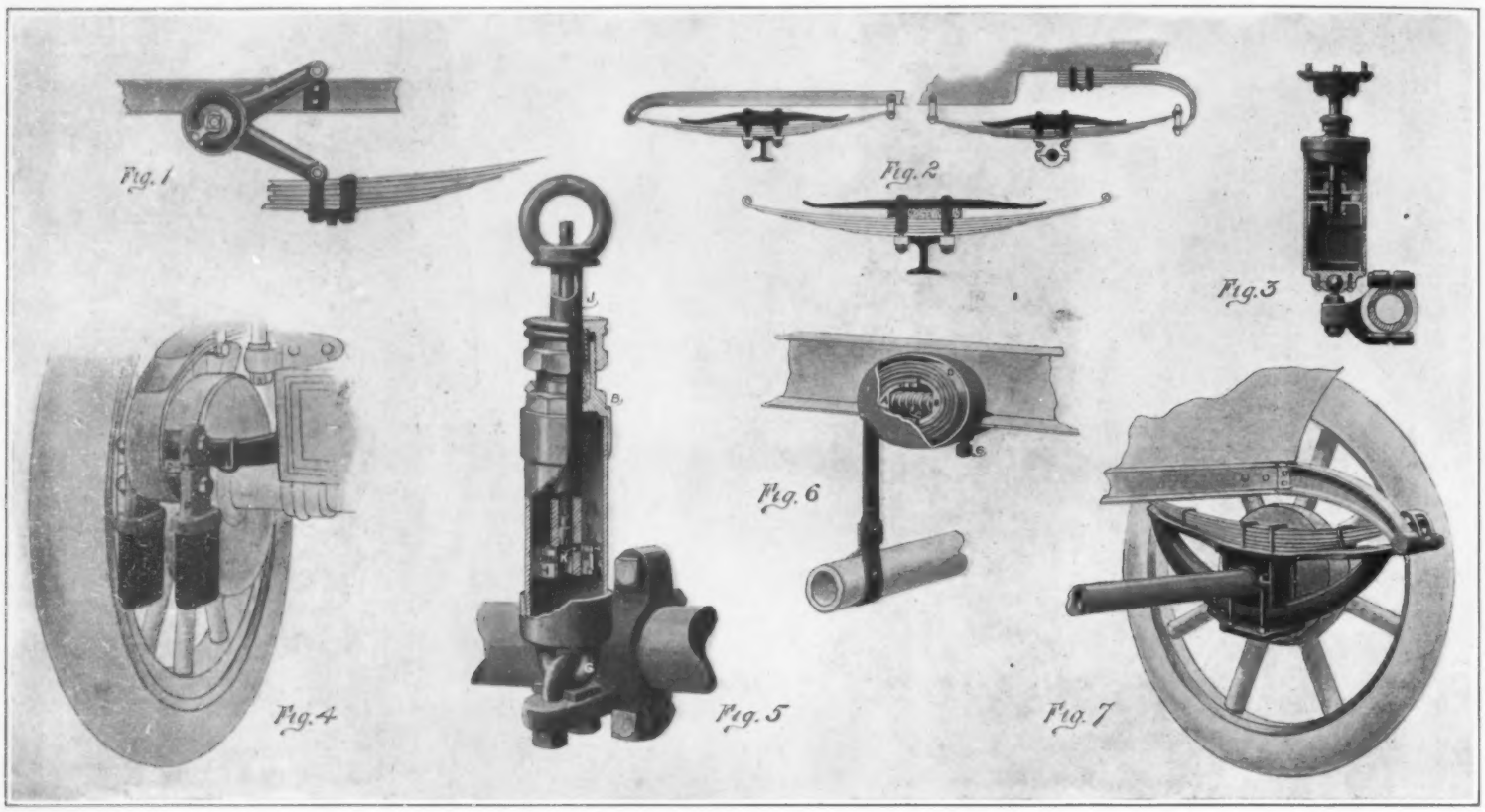


A few of the more prominent types of shock absorbers.

Fig. 1.—Elbow type. Fig. 2.—Auxiliary spring. Fig. 3.—Air cushion. Fig. 4.—Elastic shackle. Fig. 5.—Hydraulic. Fig. 6.—Rebound check. Fig. 7.—Pneumatic tire spring.

Shock Absorbers for Automobiles

ANY device attached to an automobile to prevent the too violent deflection of the springs of the car or to eliminate the recoil after deflection due to irregularities in the road surface, is commonly known as a shock absorber. Automobiles, almost without exception, are equipped with semi-elliptic, full elliptic or three quarter elliptic springs which are usually placed above the axles to provide a flexible support for the body. These springs are usually designed so that the average or normal load on them will give the maximum deflection. This being the case, they will provide a proper flexible support for the body and give easy riding qualities only within a certain range on either side of the normal load and maximum deflection. It was for the purpose of overcoming these difficulties that the shock absorber was primarily designed.

Where the load on the car is considerably under the normal the deflection will be very slight on account of the stiffness in the springs. Also, where the load is excessive the deflection will be violent. Shock absorbers are designed to obviate both of these drawbacks, and may be generally divided into two main classes as follows: 1. Those of the elastic spring shackle type for light loads, and 2, those which act as spring retarders or stiffeners.

The various types of shock absorbers differ so widely in construction and operation that they may be properly subdivided into six classes as follows: 1. The elbow type. 2. Auxiliary spring type. 3. Pneumatic. 4. Elastic shackle. 5. Hydraulic. 6. Rebound checks.

There are no less than forty different shock absorbers on the market to-day, but as they are all included in the above six classes it is necessary to give a description of only one of each type. The device described is, in each case, shown in the accompanying illustration.

The Elbow Type of Shock Absorber.

In Fig. 1 is shown an example of the elbow type of shock absorber which does not, like most of this type, depend upon friction for its resistance to motion. It consists of a triple, circular coil compensating spring, the ends of which meet opposite sides of an adjustable stop, part of which is connected to one arm of the device and part to the other arm. A large center bolt, 1⅛ inches in diameter, holds the case, cap, and two arms together, and is grooved to hold grease for lubricating this joint. The triple spring is 14 inches long and on a 5-inch movement of the chassis spring its total compression is only one inch. Owing to its great length compared with its extreme movement during compression, there is little liability for breakage or that it will take a permanent set from its continued action. These shock absorbers are made especially to fit a car of any weight, the tension of the spring being adjusted accordingly and the proper tension being held by the adjustable stop.

The Truffault-Hartford is another absorber of the elbow type, though it does not employ the coiled spring system. Most shock absorbers of this type operate on the friction principle. The Truffault-Hartford was fully illustrated and described in a former issue of the SCIENTIFIC AMERICAN.

The Auxiliary Spring Type.

This device, illustrated in Fig. 2, consists of a three-leaf semi-elliptic spring, made of chrome-vanadium steel. It is slightly more than half the length of the chassis spring to which it is applied. It is inverted and is in line with the master leaf above which it lies so closely as to be scarcely noticeable. Interposed between it and the chassis spring, in the center, there is a short steel block just high enough to keep the overhanging tips of the spring just touching the upper surface of the master leaf when it is under normal load position.

When the chassis spring is compressed by a shock imparted to the wheel of the car, the auxiliary does not touch it nor in any way affect it while it is being compressed, but on the recoil the tips of the spring engage with the master leaf of the chassis spring as soon as it reaches normal load position. At first it engages gently, then with gradually increasing force, checks the recoil until its sharp quick action is reduced to a slow easy motion and finally entirely overcome. The resistance to recoil is applied along the top of the master leaf of the chassis spring, thereby preventing it from being jerked upward and away from its supplementary leaves by the inertia of the car body. With each oscillation of the chassis springs the absorber makes and breaks contact with the master leaf, absorbing the little shocks entirely and protecting the body of the car and the motor from harmful vibrations.

Pneumatic Air Cushion.

The graduated air cushion, Fig. 3, consists of a hollow cylinder, closed at both ends, in which a piston moves up and down. The lower cylinder head is provided with a universal ball joint and a clamp for connecting the cylinder to the axle of the car. In the upper cylinder head the piston rod passes through a gland and is connected by another universal joint to the channel frame of the car. Through small cylindrical holes in the cylinder walls, both above and below its center, air is alternately admitted and expelled from the cylinder. These ports are so located that the aproned piston, as it moves on in one direction, will close them one after the other, until all are closed, and finally, after all are closed, retain in that end of the cylinder a sufficient volume of air to act as a cushion whenever the shock or recoil is excessive. During the closing process the pressure of the air in the cylinder is constantly increasing as one after the other the ports are closed, and in most cases of recoil the action never extends to closing all of the ports. This device operates in both directions, assisting the spring to resist compression and checking the recoil.

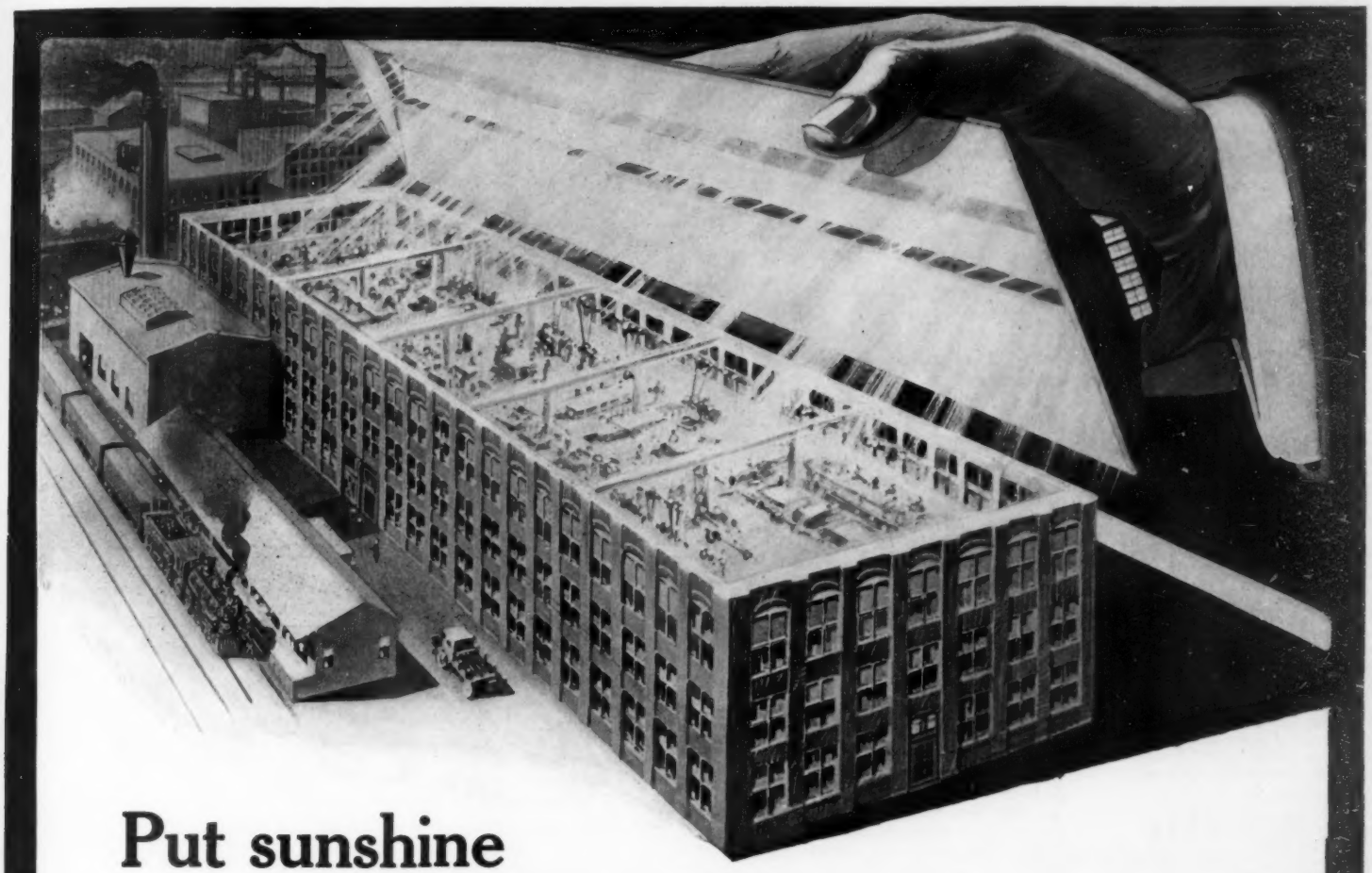
The Westinghouse shock absorber may also be included in the pneumatic class. This device was described in a former issue.

The Elastic Shackle.

The elastic shackle type of shock absorber, shown in Fig. 4, is made up of two sets of four light weight, helical wire coils. Each pair of helical coiled springs are nested, the smaller inside of the larger, giving the appearance of only two helical coiled springs inside of each housing. Two housings containing these eight coils are used on each chassis spring. They are made after designs suitable for the various forms of leaf springs, as the elliptic, semi-elliptic, three quarter elliptic, platform, etc. By referring to the drawing the reader will readily understand the construction and action of these springs.

Two steel studs *D* are fastened in the top block *A*, and pass through two holes in the sliding block *B*, which is provided with an enlargement *C* for holding the cover *H*. Two helical coiled steel springs, one nested inside of the other, surround each of the studs *D*, and are held in place by a plate and nut. The cover *H*, filled with grease, lubricates the spring and protects all moving parts from dust and grit. Two shackle pins *E* and E^1 are used to connect this device to the scroll-end three quarter elliptic spring for which it is designed. The pin *E* passes through the eye on the outer end of the lower semi-elliptic spring attached to the axle of the car, while pin E^1 passes through the eye on the end of the scroll spring attached to the frame of the car. A shock imparted to the wheel of the car will lift the axle, the main spring, and the pin *E*, com-

(Concluded on page 194.)



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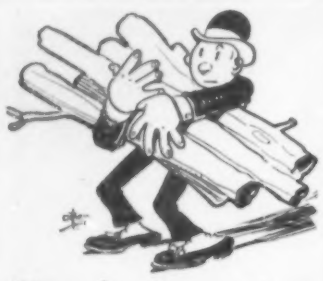

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Shock Absorber for Automobiles

(*Concluded from page 192.*)

pressing the four nests of helical springs, which vibrate so much more rapidly than the leaf springs, and act so promptly that they will bring the pin *E* back into normal position again before the shock has been felt in the body of the car. This absorber, like all of its type, of which there are several, is a very desirable refinement in automobile springs, and when properly applied and kept in good order it is a valuable addition to the automobile equipment.

The Hydraulic Type.

The shock absorber, shown in Fig. 5, consists of a hollow cylinder *A*, the piston *H*, the washer valve *I*, with vertical sliding guide-stops *F*, the hollow piston rod *J*, containing the adjustable needle valve *L* for regulating the area of ports *K*, the combination packing-box-cap *B*, the eye *M*, for connecting the piston to the channel frame of the car and the eye *G*, for connecting the cylinder to the axle.

Its action is as follows: Every complete movement of the chassis spring causes the piston to move first rapidly down in the cylinder and then slowly back again to normal load position, or slightly beyond. On the downward movement the oil in the lower end of the cylinder rushes up through the large area ports in the piston, raising the valve *I* and gradually passing up into the chamber above the piston. When the downward movement of the piston ceases the valve *I* falls, closing the piston ports. The adjustable ports *K*, always open, have a comparatively small area, which prevents the oil above the piston from returning quickly to the lower chamber, thus establishing a pressure in the upper chamber which varies in accordance with the severity of the jounce, and opposes the rapid return of the piston to its normal position, preventing excessive recoil of the spring.

Another shock absorber of this type has two cylinders instead of one and is intended to take the place of the spring shackle. This absorber may also be placed under class 4, as it combines both the hydraulic and the coil spring principles.

The Rebound Check.

The rebound checking device takes effect only on the recoil or up-stroke of the springs.

This device, as will be seen by reference to Fig. 6, consists of a circular base divided in halves, one of which *A*, is part of the casting forming the clamp containing set screws *G*, by means of which it is affixed to the channel frame of the car. The other half *B* is movable and contain a sleeve by which it is supported on a stud fastened in the casting *A*. This sleeve is surrounded by a coil spring *C*. The two-piece base is encircled by four coils of fabric belting *D* faced with a flexible brass friction band *E* attached by rivets to the inner end of the belt, and by means of its hooked inner end to the stationary half-base *A*. The outer end of the belt *D* is looped around the axle and fastened by the clamp *H*. The tension is regulated by taking up one or more holes in the lower end of the belt. The coiled belt, circular base, and coil spring are inclosed in a neat metal case which is shown partly cut away to illustrate the device.

Its action is as follows: As the car springs compress the frame and axle move toward each other, and the coil spring *C* expands, taking up the slack in the belt *D*. On the rebound the coiled belt tightens and as the coils of belting slide around over each other they create friction between the belt *D* and the brass band *E*, which is wound around with the belt *D* in the coil. This friction gradually increases as the coils tighten and in most cases of rebound no other resistance is needed. However, when greater resistance is required, the action continues until the two halves of the circular base are forced together against the resistance of the coil spring *C*, acting at all times in exact proportion to the severity of the shock to which the chassis springs have been subjected, and returning them gently to their normal position.

Pneumatic Tire Spring.

With this device the car rides as it were on pneumatic inner-tube tires without having them come in contact with the road and without the constant liability of punctures and kindred troubles.

The accompanying illustration, Fig. 7, was made from a photograph of a touring car on which these pneumatic tire springs were tested. To attach this device to a car, the old axle clips are removed and the absorber clips substituted. From these clips is suspended a platform on which rests a segment of a pneumatic tire containing an inner tube. A frame having a segment of the regulation clincher rim for engaging the tire, rests upon it, and on top of this frame the main semi-elliptic spring rests and is attached to it by the usual clips. Two air plungers, not visible in the illustration, are located below the center of the leaf spring and work in cups formed in the axle clips. They are provided to tone down a too rapid action of the device. Each device is provided with the regulation air valve for inflating and deflating the air tube.

The pneumatic tire spring shock absorber, being of the pneumatic type, really belongs in class 3, but it differs so widely in its construction and operation from any of the others mentioned above that it may be properly placed in a class by itself.

Of the many other devices intended for reducing shock in an automobile to the minimum, there are few which differ in any great degree from those already described or mentioned, while there is probably none which differs in principle of operation.

The Heavens in September

(*Concluded from page 187.*)

the beginning, and 10:30 P. M. at the end of September. As the Earth overtakes him, he grows steadily brighter, and now he appears about equal to Procyon, though only one fifth as bright as he will seem at the end of the year.

Jupiter is on the opposite side of the heavens, and very far south, so that, though not yet in quadrature, he sets about 10:30 P. M. in the middle of the month.

Saturn is almost stationary in the western part of Taurus, and appears very like Capella, both in color and brightness. He is in quadrature with the Sun on the 10th, and rises at 10:40 P. M.—a little earlier than Mars.

Uranus, which is in Capricornus (as described recently), remains above the horizon till about 1 A. M., but is best observable in the evening.

Neptune, in Gemini, rises about the same time that Uranus sets.

The Moon is in her first quarter at 8 A. M. on the 7th, full at 8 A. M. on the 15th, in her last quarter at 7 A. M. on the 23rd, and new at midnight on the 29th. She is nearest us on the 1st, farthest away on the 15th, and nearest again on the 29th, when, from the coincidence of new moon and perigee, we may expect very high tides.

During the month she passes near Jupiter on the 9th, Uranus on the 11th, Saturn on the 22nd, Mars on the 23rd, Neptune on the 25th, Venus on the 27th, and Mercury on the 30th. The conjunction with Venus, which occurs about 4 P. M., is close, but both bodies are low in the west, under the Sun, and almost unobservable.

Gas-driven Russian Ships

THAT internal combustion engines of increasing size are being used for vessels in various parts of Europe is shown by the fact that the Russian navy is now engaged in building two vessels at the Nicolaieff docks, which are of 12,000 tons draught. On the other hand, the German navy is constructing a new type of marine motor of 8,000 horse-power size. England already possesses boats of the "Eavestone" class having four-cylinder engines of 1,000 horse-power, and is going into the construction of a new vessel engined at 6,000 horse-power, using a newly designed type of 6-cylinder oil engine.

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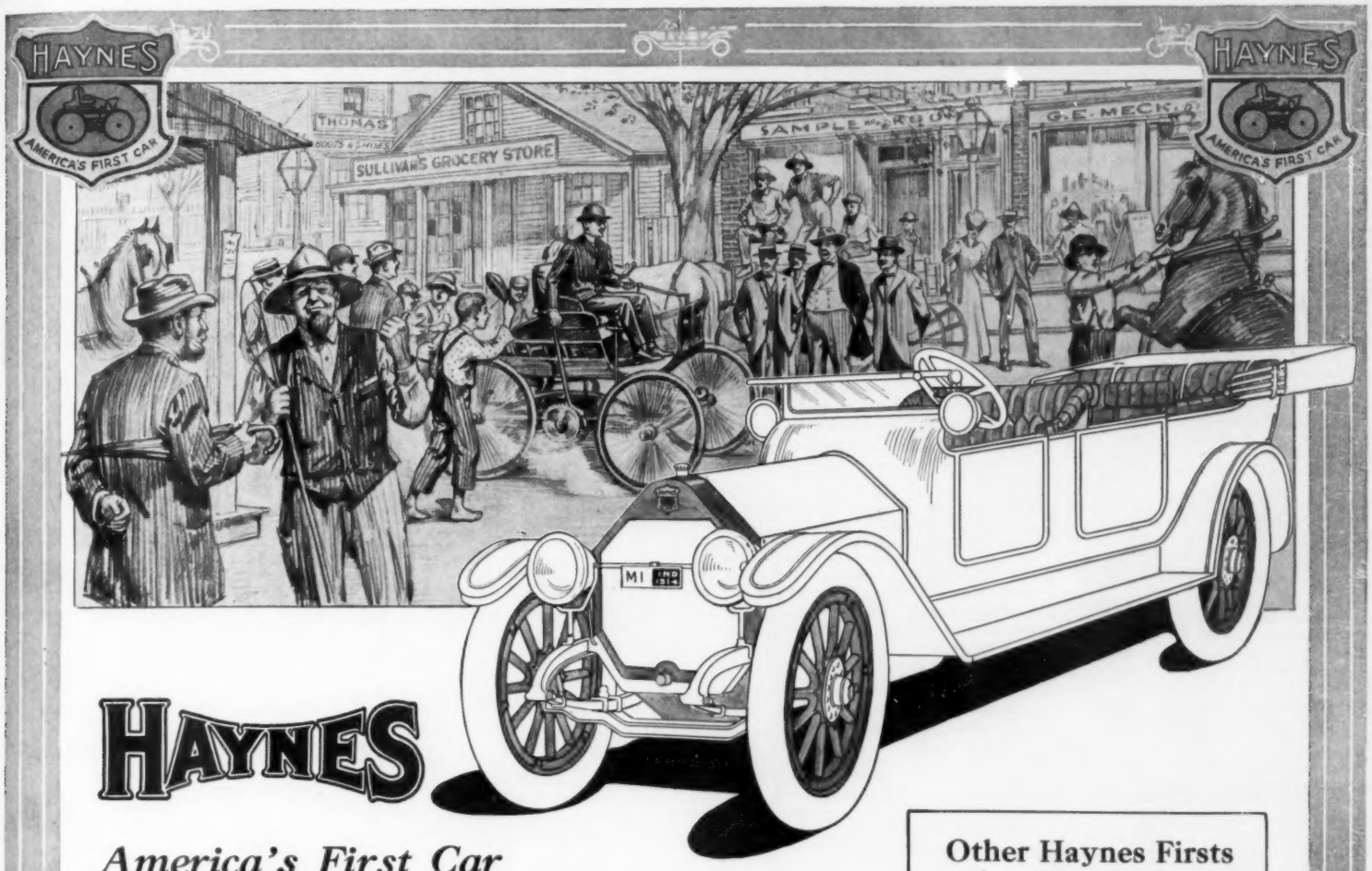

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OVERSHOE.—M. H. SIEGEL, 921 Whitlock Ave., Bronx, N. Y., N. Y. This inventor provides an overshoe which may be folded for transportation or storage; constructs an overshoe from non-elastic material and in such manner as to be adapted for the insertion of the wearer's foot; and provides an overshoe for temporary use.

Pertaining to Aviation.

AVIATION APPARATUS.—T. W. CAREY, Jr., 809 Canal Street, New Orleans, La. The principal object of this invention is to provide an apparatus for training new aviators in the art of flying. It consists of two tracks, one superposed above the other, upon which a pair of trolleys run. Between the trolleys, the aeroplane is supported and may be safely operated by an inexperienced person without danger of going too high or too low.

Electrical Devices.

SWIVEL JOINT FOR ELECTRIC CONDUCTORS.—C. TWINING, 39 Leonard Street, New York, N. Y. The invention provides a simple and improved construction of swivel joints whereby a portion of the conductor may be turned relatively to the other without entanglement. This result is accomplished with very few parts, reducing the cost of manufacture to a minimum.

BEET TOPPER.—C. W. FORD, care of Williams Street Dairy, Findlay, Ohio. The improvement in this beet topper consists in the provision of mechanism for supporting a series of beets alongside one another, and with the tops extending in one direction, and for moving the beets in succession beneath a topping mechanism that will remove the tops. The mechanism is arranged to be drawn through the field.

COTTON CLEANER AND SEPARATOR.—S. F. KRUPP, Box 1697, Atlanta, Ga. In order to open completely the bolls of cotton and detach and separately discharge the cotton fibers from the hulls and dirt and repass the unopened bolls through the machine, Mr. Krupp has invented a machine which employs a suction chamber provided within with a means for breaking the bolls of cotton, and separating and discharging the fibers.

Of Interest to Farmers.

BEET TOPPER OR CROWNER.—J. B. DAWSON, P. O. Box 57, Pompeys Pillar, Mont. This automatically operated device is attached to existing lifting machines without essential change in said machines, and wherein means are provided for crowning the individual beets while yet held in position in the ground before being lifted by the lifting mechanism, at a depth determined by the size and height of the beet itself, and wherein means are also provided for permitting the device to be moved into or out of operative position.

FOLDING HOPPER AND SUPPORTING FRAME THEREFOR.—P. C. GROSE, Blanchard Township, Ohio. This invention is readily portable, and by its use when the hopper is placed near the pile of stalks and lowered to a short distance above the ground, both the shelling of the kernels and the scattering of the ears will be reduced to a minimum, thereby preventing a very material loss of corn and time. By employing a few ordinary grain bags, or one large one specially made, corn may be bagged as it is husked. The hopper is also capable of use in filling bags with small grain.

FERTILIZER DISTRIBUTER.—J. S. DUNGAN, Lemoncove, Cal. This invention is more particularly intended for embodiment in a fertilizer distributer especially adapted for orchard use. An object is to construct an implement having improved adjusting means whereby to run the implement to any desired depth.

Of General Interest.

COMPOSITION OF MATTER.—J. B. GILBERT, Knoxville, Pa. This invention relates to composition of matter, more particularly compounds for preservation of soles of shoes. The aim is to provide a composition which prolongs the life of the shoes, and which can be made from inexpensive materials. The leather is made waterproof without destroying its pliability.

FRUIT AND FLOWER CUTTER.—C. F. BILLAU, 1430 Second Ave., Cedar Rapids. This device is adapted to be placed on the finger, the body member of which is made of resilient material and of spiral conformation, and having a longitudinally extending bearing portion against which the finger may engage when the device is in use, thereby providing for more secure holding of the device on the finger at such time.

OVERSHOE FOR HORSES.—C. R. CRAM, 253 W. 22nd St., Manhattan, N. Y., N. Y. The inventor's object is to provide an overshoe, the tread portions of which may be readily replaced when worn or when a different character of tread is desired; further, to provide an overshoe in which the hoof-supporting superstructure with contact with the hard front portion only of the hoof.

APPARATUS FOR BUILDING FOUNDATIONS AND WALLS.—G. F. MILLS, Cottagehill, Fla. The object here is to provide an apparatus having forms, spaced apart, between which the concrete may be deposited, a bracket being connected with one of the forms for carrying a platform, which is used when the concrete is deposited, there being means for raising the forms and the bracket simultaneously.

METHOD FOR CONCENTRATION OF ORES.—O. J. ADAMS, Grand Junction, Colo. In mining for rare metals, such as vanadium, uranium, etc., the amount of ground to be treated is very large for the small per cent of mineral obtained. To obtain the maximum of mineral Mr. Adams has perfected a method which consists in separating finer slimed values by mechanical means, then leaching the remaining substance by a solvent for the mineral in the ore, and then precipitating the dissolved mineral by the addition of the values obtained by the mechanical separation.

PAPER FILE.—J. MACDONALD, 218 W. 14th St., New York. This paper file is formed from a single piece of sheet material bent to provide a back and a front. The front extends upwardly and outwardly from the lower end of the back to permit of placing papers between the front and back. The front also has a rearwardly and downwardly extending spring tongue, adapted to press the filed papers against the back.

STOOL.—G. B. MCKINNEY, Barry, Ill. The invention relates to stools for use by dentists and has reference more particularly to a device of this class which comprises a suitably formed seat and the mounting for the seat which permits the same to be positively and flexibly adjusted in any direction. Means for readily controlling the adjustment are provided.

BAG-HOLDER.—S. A. OTT, Box 226, Fort Stockton, Texas. This device is adapted to be used in grocery and other stores in sets of various sizes to fit bags of different sizes. The bags in each holder are yieldingly retained in place, but may readily be removed as required.

GARBAGE INCINERATOR.—E. R. THORPE and S. C. THOMPSON, Lakin, Kansas. The incinerator comprises a plurality of inter-connecting chambers and a chimney. In addition to the main combustion chamber, there is an auxiliary combustion chamber which also causes a continuous draught through the incinerator and prevents noxious gases from remaining in the furnace and escaping into the air near the ground when the furnace is idle. The furnace may be built in any number of units, and one man can easily care for a two-unit furnace, disposing of from 20 to 30 tons of garbage per day.

Hardware and Tools.

CABLE CLAMP.—G. R. EDDELBUETTEL, Reimers, R. F. D. No. 3, Bellingham, Wash. The object in this instance is to provide a simple and comparatively inexpensive device which possesses strength and durability and which will safely and effectively clamp a cable and prevent the same from slipping in any direction.

CLASP.—A. O. BOYLAND, 1218 L St., Aurora, Neb. The intention here is to provide a simple and inexpensive clasp suitable for use, whenever it is desirable to firmly hold two flat elements together, which may be adjusted in accordance with the thickness of the substances to be grasped.

VARIABLE-COMBINATION KEY FOR SAFETY-LOCKS.—L. J. M. DARDEAU, 7 Rue Parrot, Paris, France. The invention relates to a type of key which permits of opening a lock closed by a known combination when the key usually employed for opening this lock has been mislaid or lost. The key may be adjusted according to any combination set up inside the lock by means of special elements of combination which make a part of the key.

TONGS.—N. PEARSON, Ogema, Wisconsin. The invention provides tongs adapted for logging and the like in which the leg and the hook or clawpoint are of substantial size and normally pressed toward each other so that they will grip a log regardless of whether or not the pull upon the tong is maintained, hence precluding the possibility of becoming accidentally displaced from the object, if the pull upon the tongs should cease.

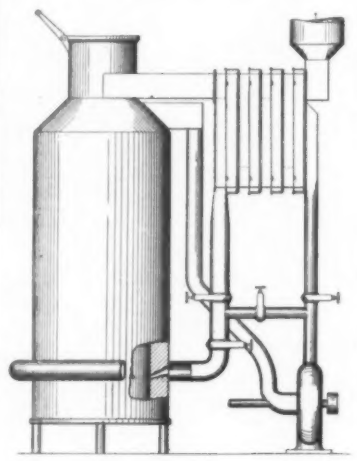
Heating and Lighting.

OVEN-RACK.—E. S. ALLEN, 517 W. 134th St., New York. This rack is so arranged that it may be drawn partly ont of the oven for conveniently placing a pan of food upon it and for inspecting the food or for basting it. The rack is collapsible and may be conveniently stored in a minimum of space. It is adjustable to fit different sized ovens.

LIGHTING FIXTURE.—J. T. ROBB, care of Mitchell, Vance & Company, 507 West 24th Street, New York. The fixture is particularly adapted for use in hospitals or sick rooms, being provided with a bracket which may readily be attached to the headboard of a bed. The bracket is steadied with a clamp whose jaws may be made to grip either a rectangular or curved surface.

VAPOR LAMP.—W. LIEDKE, Berlin-Charlottenburg, Germany. The invention relates to vapor lamps, including certain new and useful improvements in a main burner and means by which it is supplied with vapor, and a pilot flame, the latter operating to start the main burner and being itself cut off, when the main burner is lighted. The cutting off of the pilot flame is accomplished by a thermostatic valve.

ECONOMIZER.—L. L. GOBB, Box 285, Marshfield, Oregon. Among the principal objects which this invention has in view are: To provide a system for supplying to a furnace cupola air which has been heated by escaping



ECONOMIZER FOR TRAPPING MINERAL MATTER IN GASES.

gases so as to separate any escaping mineral or liquid matter held in suspension; to provide means for cleaning the apparatus; and to provide an apparatus which may be expanded or contracted at will.

Machines and Mechanical Devices.

MACHINE FOR MAKING PAPER BAGS.—F. HEPP, Tempelhof, near Berlin, Germany. The machine is designed to make flat bags of both rectangular and triangular form. The blanks, after they have been folded are conveyed at an angle depending on the form of the bag, to the apparatus for closing their lap. While the laps are being folded and stuck, the blanks are being moved continuously.

WELL-CASING PERFORATOR.—A. C. GRAHAM, 311 Cherokee St., Barthesville, Okla. The present invention is an improvement on one secured previously by Mr. Graham, and belongs to the class in which rotary perforating wheels are used to produce a plurality of rows of perforations longitudinally on the well casing, during movement of the perforator in one direction. Anti-friction devices are used to reduce the friction produced by the lateral thrust of the perforating wheels.

OYSTER-DREDGING MACHINE.—N. A. LYBECK, 1 Madison Avenue, New York city. Mr. Lybeck's invention provides a continuous acting dredging mechanism which may be supported upon any of the usual vessels and which will excavate from both sides of the vessel and convey the oysters into the bins. Means are provided for moving the vessel laterally and also for permitting the vessel to roll and pitch without disturbing the mechanisms on the sea bottom.

HIGH PRESSURE VALVE.—J. LANGSDORFF, Jersey City, N. J., and L. KRUG, New York, N. Y. Address care of Joseph Langsdorff & Co., 314 E. 21st St., New York, N. Y. The principal object of the improvement is to provide a valve which will be maintained in closed position through the aid of a spring, assisted by the pressure of the fluid passing through the valve, opening of the valve being brought about through compression of the spring.

RECIPROCATING SCOOP DRAG.—J. W. SACKETT, Jacksonville, Fla. The invention has reference to hydraulic dredging machinery, and particular reference to attachments for the lower end of the hydraulic pipes through which the dredging material, such for instance as mud is to be conveyed.

APPARATUS FOR SETTING AND CASTING SEPARATE TYPES ON LINOTYPE MACHINES.—F. SCHIMMEL, 77 Rue de Bagneux, Montrouge, Seine, France. The essential feature of this invention consists in taking a separate casting from each matrix in a line of matrices composed on the machine for casting lines of type, after the line has been cast, this being effected before distribution or return of matrices into their magazines. As the operations of casting separate types from separate matrices and distribution of the latter, are effected during composing of a second line, no loss of time results and in this manner the matter to be printed is set up in duplicate by a single machine controlled by a single operator.

LATHING DEVICE.—W. W. PALMER, Box 88 Tottenville, S. I., New York, N. Y. This invention has particular reference to woodworking apparatus for use in applying common laths in building construction. Through the work of this device a considerable number of laths may be arranged in relative position, properly spaced, ready for application to the studding, whereby the laths may be applied with accuracy and rapidity.

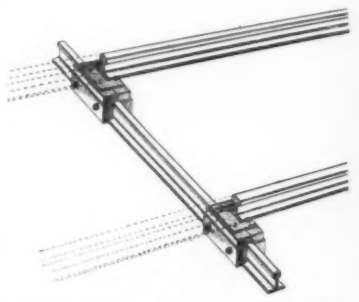
FIRE ESCAPE APPARATUS.—K. L. ELSNER, 882 Union St., Brooklyn, N. Y. The improvement comprises a simple and novel combination of elements which can be easily and cheaply installed and which can be operated by any one for the purpose of escaping or assisting others to escape from the building to which it is applied, on the outbreak of a fire.

Prime Movers and Their Accessories.

ROTARY ENGINES.—J. F. NETTLE, P. O. Box 1,057, Butte, Montana. This rotary engine is provided with a cylindrical member covered with wire wool fitting snugly against the casing in which the cylindrical member is adapted to rotate. The fluid directed against the matted wire wool, may expand considerably in the openings in the wool.

Railways and Their Accessories.

RAILWAY CROSS-TIE.—R. H. PINKHAM, Derry, Westmoreland County, Pa. This invention has for its object the construction of cross-ties in such a manner as to utilize old

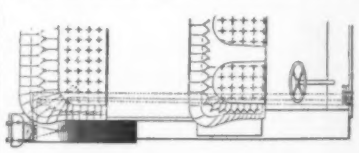


RAILWAY CROSS-TIE EMPLOYING OLD RAILS.

or discarded fragments of running rails so that they will constitute the principal portion of cross-ties. The invention covers certain cushioning devices, and special means for securing the cushioning device to the rail.

Pertaining to Vehicles.

SIGNALLING DEVICE.—M. J. MANDELBAUM, 332 West 145th St., New York. An improved signalling device is here provided for use on automobiles whereby the chauffeur may display a turnout sign or a stop sign by day



SIGNALLING DEVICE FOR AUTOMOBILES.

or night, and also sound an alarm. The signs referred to are normally retained in a compartment, but may be swung sidewise into view when desired.

SLED ATTACHMENT FOR AUTOMOBILE.—F. F. STADIG, St. Francis, Maine. The invention provides a sled and propelling mechanism therefor attachable to standard makes of automobiles without altering the car other than to remove the wheels. Propulsion is secured by means of chains fitted with spikes and driven through suitable chain and sprocket gearing from the rear axle of the car.

Designs.

DESIGN FOR CARPET OR RUG.—E. W. TRIK, care of Beattie Manufacturing Company, Little Falls, New Jersey. The patent covers a flowered design, the main body of which consists of flowered squares, about which is an elaborate border of conventional leaves and flowers.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Intra-coastal Canal System for the Atlantic Seaboard

(Concluded from page 185.)

the need for a completely sheltered waterway between Narragansett Bay and Boston should receive further consideration. He was of the opinion that, after the completion of the Cape Cod Canal, the question of its acquirement by the Government, based upon its value as a going concern, might be worthy of further consideration.

The next link in the Intra-coastal Waterway is what is known as the Narragansett Bay—Long Island section. This route leaves Narragansett Bay at Bissel's Cove, and follows a series of tidal streams and lagoons to Long Island Sound, opposite Montauk Point—one object of this diversion being to avoid the dangers of navigation around point Judith. The Army Engineers estimates showed that a canal 18 feet deep would cost $11,399,205 and that one 25 feet would cost $24,736,635. The Special Board was favorable to the construction of the smaller canal; but the Board of Engineers of Rivers and Harbors differed from them, believing that the canal afforded practically no saving in distance over the outside route, and that boats would probably prefer the latter, except in stormy weather. They designated this as the "least-needed link" in the whole scheme. The chief of engineers concurred with this view of the Board of Engineers, believing that the full benefit to be derived from the construction of a canal 18 feet deep could be obtained only on the completion of the sections of the waterway to the south.

The SCIENTIFIC AMERICAN is of the opinion that on the completion of the Cape Cod Canal, the protection afforded by Cape Cod Bay, Buzzard's Bay, and Long Island Sound will be sufficient to meet the commercial necessities of the situation for many years to come.

New York—Delaware Canal.

Although the report of the Army Engineers is unfavorable to the construction of that part of the intra-coastal canal scheme which lies to the eastward of New York Harbor, they favor the construction by the Federal Government of the proposed waterway extending from New York to Beaufort. Regarding the New York Bay-Delaware River section, the Special Board found that it would be inadvisable to purchase the existing Delaware and Raritan Canal, and they recommended that a new sea-level canal with a depth of 25 feet, connecting Raritan Bay with the Delaware at Trenton, be constructed at an estimated cost of $45,000,000. The General Board, however, considered it improbable that the commercial benefits of a 25-foot sea-level canal 72 miles in length would warrant the large expenditure. They claimed that, for the expected traffic of 5,600,000 tons, such a canal would show no advantage over a double-track freight railroad. The Board argued that, since the principal estimates for a saving by this route were based on calculations for one thousand and two thousand ton barges, and since either of these can be accommodated on a depth of 12 feet, it would be advisable for the present to build a canal of that capacity only.

General Bixby in his report of August, 1913, recommends the construction of a lock canal, 12 feet deep and 90 feet wide, from New York Harbor to the Delaware River, at a total cost of $20,000,000. He suggests that it be so built as to provide for an economical enlargement to a depth of 25 feet and a width of 125 feet, and for its ultimate excavation to sea level.

Delaware River-Chesapeake Bay Section.

After examining all practicable routes in the section from the Delaware River to Chesapeake Bay, the Special Board selected and surveyed a route along the line of the present Chesapeake and Delaware Canal, which reaches from Delaware city on the river of that name, to Chesapeake city at the head of Chesapeake Bay. This examination showed that a canal 25 feet deep, along this route, would cost to build

(Concluded on page 199.)

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Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12844) W. W. S. asks: As we are subscribers of long standing to the SCIENTIFIC AMERICAN, I take the liberty of asking you a question to settle a dispute. In the tropics, where the crews of vessels are unable to get cool water to drink, it is said they use a "porous" jar called a "monkey," place same in a draught, and the water becomes much cooler than the surrounding atmosphere. Is this a fact or not? A. Porous jars for cooling water are in use in the tropics, and have long been used by the natives of the torrid regions. Where the cocoanut grows, the milk in the nut is always deliciously cool, although it hangs on the tree under a torrid sun, as we have proved to our delight. The reason is this: Evaporation cools water or any other volatile liquid. The wind blowing past the porous jar hung in the air from a tree limb or under a ship's awning carries away the moisture which has exuded through the pores and is on the outside of the jar. This makes way for more water to come through and be evaporated. The heat necessary to evaporate the water comes in part from the water itself, which thus becomes cooler even while the sun may be shining upon the jar. We cool ourselves by fanning in the same way. The reason why a hot day with a high humidity is so hard to endure is that the moisture which exudes from our bodies is not so freely evaporated from the skin as when the humidity is lower. We can endure a high temperature with much less discomfort when the humidity is low than when the humidity is high. When the humidity is high the water in the jar will not evaporate so rapidly nor become so cool as when the air is dry and the humidity is low. Such jars are sometimes to be had here. An ordinary brick red flower pot with a cover would answer the purpose.

(12845) R. S. W. asks: If possible, will you please inform me if there are any established systems for generating and storing electricity, for lighting purposes, by use of the wind-mill? A. There have been several instances of farmers and others employing wind-mills for driving a dynamo for charging a storage battery, and in this way lighting their places with electricity. One of these is described in the SCIENTIFIC AMERICAN, vol. 107, No. 13, and another in No. 26 of the same volume. We will send you these papers for ten cents each.

(12846) W. H. T. asks: Would it be practical to build the case or jars for a small, light storage battery out of wood, boiling the wood in paraffine first. Or is there some other better acid resisting cement or paint? A. We do not advise making battery cells of wood. They will stand for a little while, but the acid ultimately gets out. The joints are with difficulty made tight. Sulphuric acid can only be held in earthenware, glass or hard rubber vessels. Asphaltum and paraffine are the only coatings which resist sulphuric acid for any time.

(12847) L. G. B. asks: 1. Is it possible for a wave (e. g., a sound-wave) to advance at a greater velocity than the linear velocity of the particles (or molecules) of the medium transmitting the wave? If so, explain. A. The velocity of a wave, and the velocity of the particles of the medium through which the waves move are two distinct motions. The wave form moves on continuously with a uniform velocity. In the case of a sound this velocity is 1,000 feet a second at the freezing point. The air particles in the wave move backward and forward for a limited distance. Both distance and velocity diminish as the sound dies out. The intensity of a sound depends upon these, while the pitch depends upon the wave length or the number of waves per second. The pitch remains constant so long as the tone is audible, which shows that the velocity of the wave does not alter as the sound moves outward from its source. 2. The solar system is believed to be moving as a whole in a certain direction. Regarding the solar system as a disk, is it moving with its face forward, or its edge forward? A. The sun is moving toward a point on the borders of the constellation Hercules, according to Newcomb, whose right ascension is about 277 degrees 30 minutes, and declination 35 degrees north. This is neither in the plane of the Ecliptic nor at right angles to it, so that the solar system, regarded as a disk, moves obliquely to its plane. Each planet describes a spiral around the sidereal path of the sun. A discussion of this topic may be found in Young's "Manual of Astronomy," which we send for $2.50 postpaid.

(12848) C. A. deL. asks: Could you give me information regarding liquified air experiments, and what has been accomplished, or direct me to the book or magazine with the above information wanted? A. We can supply you with all which has been written about liquid air. Our book, Sloane's "Liquid Air," price $2, covers the history of the subject to the time of its publication. Our SUPPLEMENTS give the experiments with liquid air and a fuller description of the various types of machines of the different investigators in this line, as well as the uses which have been made of this curious liquid. We name SUPPLEMENTS Nos. 1217, 1154, 1174, 1186, 1187, 1162, 1303, 1226, 1278, 1170, 1542, 1524, 1528, 1588, and 1958, which we send for 10 cents each.

(12849) E. O. T. writes: Some time ago an article appeared in your Query columns regarding the weight of a body on the equator, and at the poles. The statement was made that partly owing to the centrifugal force at the equator, and partly because the poles are nearer the earth's center, the body would weigh more at the poles. This law is frequently referred to in astronomies, and the reason advanced is the difference in the oscillations of pendulums of the same lengths. Might not the difference in weight at the two points be accounted for wholly by centrifugal force? If the body in question were lowered into a deep shaft, it would not increase in weight, notwithstanding the fact that it was nearer the center of gravity. On the other hand, it would actually weigh less, owing to the attraction of the matter above it, and at the center of gravitation would weigh nothing. Why, then, should it weigh more at the poles. Were the earth rigid and to cease revolving on its axis, thereby doing away with centrifugal force, it would seem that the body would weigh most at the equator, for the reason that, more matter was exerting a downward attraction on it, owing to the elliptical form of the earth. If the body were at the poles, there would be less matter exerting a direct downward attraction, the equatorial bulge acting on it at a larger angle, and consequently, exerting less of a pull. The point I am trying to make would be better illustrated by supposing the earth to be very oblate, say only a mile or two in diameter between the poles. Would the body then weigh more at the poles, say a mile from the center of gravity, and with only a small portion of the earth's mass exerting a downward attraction, and the greater portion acting only at an angle, and partially neutralizing this attraction by acting in opposite, or nearly opposite, directions, than it would on the rim or equator, with the greater part of the mass acting nearly vertical upon it, although very distant from the center? A. The increase in weight from the equator to the poles is not accounted for wholly by the decrease of centrifugal force as one goes toward the poles. Centrifugal force diminishes weight at the equator by 1/289, while weight at the poles is greater by about 1/190. The difference is due to the shape of the earth. A body is about 13 miles nearer the center of the earth at the poles. This causes an increase of weight. Your reasoning on this point is not sound. Distance from the center of gravity affects weight in the inverse ratio of the square of that distance, while quantity of matter affects weight directly as that quantity. It must be seen from this that a change of distance will affect weight more than the same amount of change in the quantity of matter, causing the attraction. The quantity of matter attracting a body is a very little less at the poles, and the decrease of distance causes an increase of weight in the ratio of about 3963.296 miles^3 to 3949.790 miles^3, these being the polar and equatorial semidiameters of the earth which are employed by astronomers in their calculations. Your statement is not correct that the matter in the earth which is above a body causes it to weigh less. It is shown in mechanics that a body within a spherical shell will be attracted equally in all directions by the matter of the shell, and thus would have no weight. For this reason only the mass of earth in the sphere below a body causes it to have weight, and the weight of a body below the surface of the earth varies directly as its distance from the center of the earth. A body at the center of the earth weighs nothing because there is no matter nearer the center to attract it and give it weight. The sphere outside of it attracts it equally in all directions and does not affect its weight. The equatorial bulge pulls equally on a body at the poles all around it and thus does not affect the weight at the poles. These considerations will explain the extreme case which you suppose of a broad disk with a very short polar axis. There would be a very small amount of matter in the sphere below the body since nearly all the matter is in the equatorial ring. This is not the case with the earth. These matters are discussed quite fully in Young's "General Astronomy," which we send for $3.05. There is no astronomer nor physicist who thinks a body weighs *less* at the poles, or that the difference in weight is accounted for wholly by centrifugal force.

(12850) M. A. C. asks: Can you give me the name of any substance which is a non-conductor of sound? A. All substances which possess any degree of elasticity are conductors of sound. Loose material of almost any kind will be a poor conductor. If the space between two walls is filled with shavings, wool, cotton, feathers, small lumps of broken mortar or any similar material, it will not conduct sound, and thus it deadens the walls as it is commonly termed.

NEW BOOKS, ETC.

YEARBOOK OF THE UNITED STATES DEPARTMENT OF AGRICULTURE. 1912. Washington: Government Printing Office, 1913. 8vo.; 781 pp.; illustrated.

The general makeup of the Yearbook is prescribed by law, but each year becomes progressively interesting, and the richer by one year in comparison. This feature alone, comparative statistics, makes the work most instructive to the man who would know his country's advancement in productiveness, and makes it indispensable to certain public speakers and educators. The body of the work, presenting the report of the Secretary, is as varied and informing as ever. It is followed by twenty-four special articles on such subjects as promising new fruits, improving quality in poultry and eggs, and insect enemies of live stock. The book has some good reproductions of fruit in color, in addition to sixty half-tone plates of diversified character. The frontispiece is a portrait of the Hon. Norman J. Colman, the first Secretary of Agriculture, who died in 1911.

ELECTRICITY FOR THE FARM AND HOME. By Frank Koester. With an Introduction by Thomas Commerford Martin. New York: Sturgis & Walton Company, 1913. 16mo.; 279 pp.; illustrated. Price, $1 net.

The intensely modern note of this work is struck in the frontispiece plate entitled: "In the Glow of an Electric Radiator." Positive and practical assistance is offered in concise form to the man living at a distance from cities and libraries who is yet broad-minded and progressive enough to want to improve his condition of living. To this end the author, an expert in his subject, gives simple detailed directions for equipping a farm house and its outbuildings with electricity. The various methods of generating the power are explained, and the many possible applications of the small electric motor are set forth, from water pumps and churns to ice-making and dish-washing. The cost of such operations has not been neglected, but is treated in a separate chapter. Plowing, heating, the telephone, irrigation, these and other diverse applications are profitably discussed. Review questions at the end of each chapter give the work added value as a text book.

SAFETY. Methods for Preventing Occupational and Other Accidents and Disease. By William H. Tolman, Ph.D., Director of the American Museum of Safety, and Leonard B. Kendall. New York: Harper & Brothers, 1913. 8vo.; 422 pp.; illustrated. Price, $3 net.

Last year, by the adoption of safety devices such as are described in this volume, The Pennsylvania Railroad Company reduced their serious shop accidents 63 per cent and the United States Steel Corporation reduced theirs 45 per cent. This bears out the opinion of the engineering profession that one half our industrial accidents are preventable. Are there reasons, aside from the humanitarian aspect, why our efforts should be bent toward safeguarding our workers? The volume in hand answers this question in a manner to silence all argument. Each wage-earner is an economic asset of the nation; every such asset temporarily or permanently removed from activity becomes a liability, a charge upon the nation that is evident in increased burden upon the taxpayer through the channels of such city departments as health, charity, education, or police, to say nothing of the wasteful expenditures represented by civil suits. The authors have not taken the impossible as their aim and object. Germany conserves annually the amount our own criminal carelessness flings away. We have half a million industrial accidents every year, at a social and economic loss of $250,000,000. Shop hygiene, another factor of industrial efficiency and economy, is also considered at length. In short, the ground has been well covered, and the result is a thoroughly commendable volume.

BULLETIN OF THE BUREAU OF FISHERIES. Vol. XXXI. 1911. A Biological Survey of the Waters of Woods Hole and Vicinity. In Two Parts. 8vo.; 860 pp.; with charts and maps. Washington: Government Printing Office, 1913.

Part I of this issue of the Bureau of Fisheries is divided into two sections, the first dealing with physical and zoological aspects, the second with botanical. Part II also has two sections, the first being a catalogue of the marine fauna, the second a catalogue of the marine flora. It is pointed out that faunistic and floristic studies are justified both from scientific and practical points of view, and the thoroughness of investigation shown by our Government reports in general, and by the present issue in particular, commends this survey to all naturalists.

FRANCE FROM SEA TO SEA. By Arthur Stanley Riggs, F.R.G.S. New York: McBride, Nast & Co., 1913. 8vo.; 315 pp.; illustrated. Price, $1.25 net.

The author of "Vistas in Sicily" gives us much more than a charming glimpse of French landscape and architecture and character, in their varied manifestations from sea to sea. He pities the misguided souls who miss the enchantments that the wide French countryside unfolds, for the feverish frivolities that the city of Paris affords. And in the end the reader is inclined to agree with him. Mr. Riggs's style is happy, and no one can regret wandering with him over the golden sands of Picardy, through the picture-book country that lures us on to Grenoble, ever southward to Grasse and the Riviera, and down to the halcyon coasts of old Provence. The illustrations are well-selected and generally good. Altogether one might do far worse than spend an hour or two of healthful relaxation in accompanying the author in his pleasant book-jauntings through France.

A MODEL FIRE-PROOF FARM HOUSE OR COUNTRY HOME. Practical Suggestions for Economical and Enduring Construction, with Complete Plans and Specifications of a Model Building. By A. L. A. Himmelwright, M. Am. Soc. C.E., etc., New York: The Neale Publishing Company, 1913. Oblong 4to.; 72 pp.; 26 full plans. Price, $1.

The attractive house presented in these plans is one of sixteen rooms of convenient and pleasing arrangement. The author's object in urging substantial fireproof construction is a laudable one, and his explanations and specifications go at once to the heart of the subject in an understandable manner. Coming to price schedules, it is our impression that only an exceptional man with exceptional opportunities could obtain supplies and labor at the low figures there given. Mr. Himmelwright's construction is generally sound in principle, although it is not in accordance with the best modern practice to make the chimney support the roof, as seems to be the case here. However, anyone contemplating the erection of a fireproof country home will find in the volume, suggestion, information, and inspiration to no small degree. A modification of the plans as applied to a ten-room dwelling is a welcome addition to the work.

THE PROCEEDINGS OF THE OPTICAL CONVENTION. 1912. Held at South Kensington June 19th to June 26th, 1912. Vol. II. London: University of London Press. 8vo.; 359 pp.; illustrated. Price, 10 shillings net.

Addresses and papers by leading scientists and experts make the report of the Optical Convention of 1912 very instructive reading. There are reviews of the advancement made in the optical art, observations on such topics as the measurement of light and illumination, new spectral color-mixing apparatus, diffraction images, and the ideal photographic lens. In conclusion, the work presents as an appendix a table for calculating spherical aberration.

A POPULAR DICTIONARY OF BOTANICAL NAMES AND TERMS. With Their English Equivalents. By George Frederick Simmer, New York: E. P. Dutton & Co., 1913.

This little dictionary, as its introduction tells us, is intended for the use of lovers and students of plant life and garden, field, and wood. As most botanical names convey so little meaning to those who are not linguists, the intelligent botanist will find here a useful companion when rambling through wood and field. The book differs from most reference works of a similar character inasmuch as it devotes far more attention to specific names than is ordinarily the case. Hence, those who are unfamiliar with classic languages will find it particularly useful.

LES SOURCIERS ET LEURS PROCÉDÉS. La Baguette, le Pendule. Par Henri Mager, Ingenieur-conseil en Hydrologie Souterraine. H. Dunod et E. Pinat, Paris: 8v.; 314 pp.; 107 figures.

Scientific Europe's interest in the divining rod has been revived. In Germany a society has even been founded for the express purpose of studying the phenomena of the divining rod. In France the subject has provoked so much discussion that some very elaborate experiments were recently made at Sartrouville, Bois de Vincennes, and Chateau Mirabeau, throwing light on the reality of the phenomena observed. The author of this book was the president of the jury charged with conducting the experiments. Special instruments were devised to measure the force exhibited, and moving pictures were made of divining rod manipulators in action.

The author seems to feel that there can be no longer any doubt as to the genuineness of a divining rod manipulator's exploits. We are assured that "the impressions received by the divining rod manipulator . . . . are due to his having entered a field of influence created by an electric current, a liquid current, a gaseous current, or in a more general way by anybody at all." It is stated that the sensitive person is impressed by the lines of force of the field of influence. The natural force most widely encountered is electricity, but the author believes it would not be prudent to regard the manifestations of the divining rod as electrical in nature. He is more inclined to regard them as exhibitions of a new force, hitherto unknown, a force which he tentatively calls a "prolongation of matter." He dismisses too lightly the possibility that the wielders of the divining rod, admitting their honesty, are subject to the same subconscious promptings as those who write "automatically" and have hallucinations. This psychical phase of the inquiry might have been elaborated. Whether or not we accept the performances of water finders as genuine, it cannot be denied that the book written by Henri Mager is remarkably interesting and remarkably instructive; indeed, probably the best compendium and the best report on original observations thus far published.

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$9,910,210 and the Board recommended that the Chesapeake and Delaware Canal should be acquired by purchase of $2,514,290. This canal is ten feet deep and is of the lock type, the locks being 24 feet wide by 220 feet long. It was suggested that the change to 12 feet be made gradually, and in such way as to interfere as little as possible with existing traffic.

General Bixby, in his recommendation made to Congress this month, advises that the Government should purchase the existing Chesapeake and Delaware Canal connecting the Chesapeake and Delaware Bays, at a cost not exceeding $2,514,290. He further recommends the expenditure of approximately $8,000,000 by the Government in transforming this canal from a lock canal into a sea-level canal with a depth of 12 feet throughout and a ninety-foot width at the bottom—the deepening of this canal to 25 feet being postponed until after the effect of the new 12-foot canal on commerce is apparent.

Norfolk-Beaufort Inlet Section.

After examining all practical routes of the section from Norfolk to Beaufort, the Army Engineers selected and surveyed as the most available a route *via* the Albemarle and Chesapeake Canal, Currituck Sound, Alligator River, Rose Bay, and Adams Creek. The plan was prepared for a canal having a depth of 12 feet and minimum bottom of 90 feet. It was recommended by the Special Board and approved by the Board of Engineers and the Chief of Engineers, that the existing Albemarle and Chesapeake Canal should be purchased for $500,000, and that $2,235,000 be spent for its improvement and its increase to a depth of 12 feet. The route from Albemarle Sound to Pamlico by way of Rose Bay was estimated to cost $2,215,000, the Brant Shoal cut would cost $55,000 to remove, and the section of canal from Pamlico Sound to Beaufort Inlet *via* Adams Creek Canal was estimated to cost $395,000. The estimated cost of construction of the whole section, exclusive of the purchase of the Albemarle and Chesapeake Canal, was $5,400,000. Congress last year made a start in the construction of the Inter-coastal Waterways by appropriating $800,000 for this Norfolk-Beaufort section, $500,000 of this amount to be expended in the purchase of the Albemarle and Chesapeake Canal, the balance to go toward active construction.

Existing Conditions.

The situation then with regard to the porposed Inter-coastal Waterway, is that the section from Boston to New York is abandoned; that the Chief of Engineers has recommended that Congress appropriate $30,000,000 for the construction of a 12-foot canal between New York and Norfolk; and that the 12-foot canal from Norfolk to Beaufort, as we have said, has been authorized by Congress and is now under construction.

Life Without Microbes

THE possibility of animal life under conditions quite free from microbes is occupying the attention of experimenters, and the Paris scientist Guyenot uses the common fly for this purpose (*Drosophila ampelophila*) obtaining their reproduction and following their descendants. He now possesses a collection of specimens dating from two years past and comprising a great number of generations. Development from the egg to the imago, at 24 deg. Cent., lasts for twelve days, and the females commence to lay on the first and second days after hatching. In this way he obtains two generations a month and each generation contains at least 10,000 flies. The line followed by him since May, 1911, includes some 40 generations or 400,000 specimens. Under these conditions, living in a medium free from microbes and feeding upon specially-prepared food, the specimens do not show any lessening in strength of fecundity, but on the contrary their development takes place under exceptional conditions which are not found in nature. While in the ordinary case the mortality during development is often great for larvæ and pupæ, it is practically nothing in the present case.

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Plain macadam gives way under the wear and tear of heavy rubber-tired automobile wheels and the surface binder of the road is torn away in the form of dust, until in time the coarse stone itself is exposed and a costly renewal of the road is necessary.

Modern roads should be built to resist modern traffic. To build any other kind is wasteful. A better binder than the ordinary mineral binder is needed and is offered in Tarvia, a coal tar compound especially prepared for use on roads.

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DON'T BE WITHOUT IT

Automobile and Improved Roads.

(Concluded from page 178.)

tions which are most carefully laid in one course and some of which have been given a paint coat of bituminous material; and fourteen sections of brick pavement laid on six inches of concrete with as many varieties of modern paving brick. Preliminary measurements of all quantities have been made on this work, and a very careful traffic census is now kept.

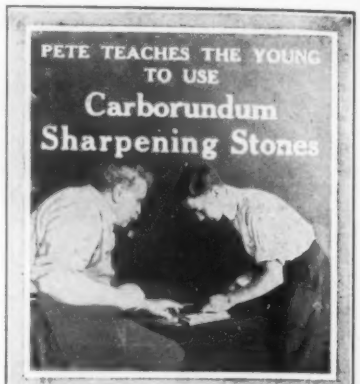
The Natural Soil Road and Its Possibilities.

Curiously enough we are forced to admit there is a possibility that the natural soil road will play an important part in the future. The natural soil road well drained and crowned is a most comfortable road during a large part of the year. Will it not be economical to give the earth and gravel road a thorough trial? In the past gravel and earth roads have not been scientifically cared for. It is now known that, with persistent dragging, natural soil roads may be kept in splendid condition except in the very worst weather. It has not yet been demonstrated that an earth road built with the same care for grading, alignment and drainage structures that would be given to a bituminous macadam road, or a brick road, may not, after all, be a very economical type of road if properly maintained. If traffic on such a road develops in the future, there will be an excellent foundation for a superior surface. One reason that natural soil roads have not been considered by modern highway engineers is because such roads have never been maintained with sufficient continuity and care to demonstrate what they can do. There is no doubt that a well-built sand-clay road, where the materials are carefully selected, is a most excellent highway. It will stand up under considerable traffic, and is very comfortable for automobiling. Of course, such a road must be maintained by skilled labor continuously.

The most economical method of annual maintenance of our bituminous bound macadam roads has not been finally determined. Last year and this year saw the first scarifying of old bituminous bound roads to any extent. From now on, there will begin to appear the necessity for resurfacing bituminous macadam highways, as some of the first roads so built are now seven or eight years old. Evidence presented at the International Road Congress in London, tends to show that high carbon tar products used for the superficial coat upon highways, tend to become weathered and are less waterproof than some of the asphaltic oils. This evidence however is not conclusive. Over a great many miles of bituminous macadam State roads in New England, a very light coat of oil has been applied twice a season where automobile traffic was heavy. The oil has been put on regardless of the dust, and forms a soft, loose layer of oil and fines which apparently protects the road surface beneath, up to a point where the automobile traffic becomes excessively dense. In neighboring States, other methods of surface treatment are in use with more or less success.

Automobile Economics and Good Roads.

When it comes to the economic benefit of the automobile, we face a problem comparable to the problem of the value of railroad transportation. The movement of passenger coaches is not always of direct economic value, and yet such transportation is an absolutely necessary feature of our modern life. It is quite common to hear it stated that the automobile is a pleasure vehicle. In the beginning of the automobile movement, the pleasure travel was doubtless very large, but it is certainly not true to-day that motor vehicles other than trucks are all pleasure vehicles. A large number of them are used for business purposes, in the same sense that the railroad car is so used. There has been an extensive readjustment of land values in many parts of the country since the advent of the automobile. Suburban property has been in greater de-



PETE'S first advice to the budding carpenter or the student craftsman is:

"Learn to take the proper care of your tools, so, first of all, get a good oil stone. Get a stone that will cut the edge on the tool, not one that rubs it on. A stone that will cut quick, holds its shape, and not glaze."

The experienced workman, too, should heed Pete's advice. He means a Carborundum Sharpening Stone. Ask your hardware man to show you the rectangular or the round combination Carborundum Bench Stone.—They are the greatest stones for all around work you could ever put in your kit. For your gouges, get Carborundum gouge stones.

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HIGH SPEED NON-GRAN BEARING BRONZE

READ of the service NON-GRAN is giving to scores and scores of manufacturers.

THIS letter was addressed to the *Scientific American* on April twenty-ninth, 1913, and was written by Mr. A. L. Carter, Production Engineer of the Bower Roller Bearing Company, Detroit, Michigan:

"Relative to NON-GRAN bearing bronze we beg to advise that we are using this bearing metal, supplied by the American Bronze Company of Berwyn, Pennsylvania, in our grinder spindles. The speed on these spindles (in internal grinders) runs up to 14,000 R. P. M. The spindles are 15/16" diameter, or approximate spindle speed of 3,400 F.P.M. Our first spindle, using NON-GRAN bronze, stood up very much longer than we expected and at the end of two and one-half months' continuous running, averaging twelve and one half hours per day, was removed as there was a wear of about .0015. It is very necessary that there is no shake in our spindles and we are getting very good results indeed from the continued use of NON-GRAN as compared to the other bearing bronzes we have used."

AND this is why NON-GRAN bearings provide longer silent action, greater efficiency and greater life to any motor or machine.

WITH the aid of a microscope, you will see that the polished surface of a bearing, instead of being one solid piece as it appears to the naked eye, is, in reality, composed of billions of minute particles. Now these particles are constantly being pulled at by the friction of the shaft revolving against them. Just as your hand would be pulled were you to hold it around a rapidly revolving shaft.

THE reason a bearing wears out is because these particles cannot resist this pull and are torn away from the billions of particles immediately back of them. As this tearing away of particles goes on, the inside diameter of the bearing keeps getting larger and larger until it no longer holds the shaft snug.

Whether or not a bearing will show rapid wear, depends upon the *structure* of the bronze and how well the constituent particles can *resist* frictional pull.

THE structure of NON-GRAN bronze is the direct opposite of the granular structure of other bronzes in which the particles have no holding bond between one another.

THE structure of NON-GRAN bronze is non-granular, it is fibrous. The particles in its construction are all knit together in a solid mass so that friction on the bearing surface cannot pull the particles from their tightly interlocked positions.

THE particles of a NON-GRAN bearing are thus absolutely secure against all normal frictional pull, and give way *only* to the very occasional abnormal pulls such as would be caused by tremendous continued shaft pressures or the almost complete absence of lubricant.

IT is clear, therefore, that the reason NON-GRAN bearings stand up for from three to five times longer than bearings of any other bronze is because NON-GRAN gives way *only* to *abnormal* friction.

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The Winnipeg Tractor Trials

Sixth Annual Event Shows Farmers Ready for General-purpose Engines

By L. W. Ellis

THE sixth annual farm tractor competition held recently at Winnipeg brought out the fact that, even in the vast prairie provinces of Western Canada, both farmers and manufacturers have satisfied themselves of the efficiency and economy of the larger, standard type of tractor, and are now more keenly interested in the medium to small tractor for general work.

A glance backward over the six contests shows a marvelously rapid evolution of the modern tractor from the experimental to the every-day stage. The present year's trials seemed to prove that from the popular standpoint, at least, the element of uncertainty was so lacking as to result in an almost complete lapse of interest. As if by common consent, farmers and manufacturers suddenly withdrew their support, and the competition among only three firms had more of a technical than a popular significance.

The first contest, in 1908, was among internal-combustion tractors only, the weight limit of seven tons barring practically everything in the way of a steam engine. The very large gallery that watched the hauling and plowing trials had quite as much interest in seeing whether all the tractors would finish the tests as in the comparative scores. Their viewpoint was substantial, for only six out of seven finished, and nearly all had difficulties that would have proved serious in actual practice.

After 1908, steam tractors were eligible, and for two years the battle was between the ponderous old steam engine and the lighter internal combustion rivals which had sprung up thickly and with growing satisfaction to the trade. The introduction of a friction brake as a substitute for the threshing separator in a stationary test gave the steamers a better chance upon their own long-occupied ground, but the contest of 1910 was distinctly a gas engine triumph. The sight of gasoline and kerosene tractors busily plowing, while all mand, speed in travel all over the country has favored business development. Of course, no one denies that a large part of automobile travel is still purely for recreation and enjoyment. The need of organized recreation and enjoyment for the more densely populated areas of this country cannot be denied. The automobile has become a social force. The increased cost of highways is merely an incident which indicates the directions in which our people are willing to increase their expenditures.

Perhaps of more direct economic significance than any item which has yet appeared is the increasing use of the automobile truck in farming operations. Apples are hauled by motor truck in Virginia and Oregon, cotton in Mississippi, potatoes in Maine, and so on. The possibilities of increasing the service of motor trucks in collecting cream, transporting perishable fruits, and kindred operations are immense. When the use of such trucks becomes common, the construction of roads will have reached a more scientific stage than ever before because the demand for such service will be exacting. While thinking on these matters it must be remembered that progress in the economic development of transportation and distribution methods is an essential and inevitable feature of our modern life.

The Third American Road Congress which occurs in Detroit, September 29 to October 4, inclusive, will have one section devoted entirely to the discussion of the technical features of highway engineering. As there will be present at this gathering most of the highway commissioners of the States actively engaged in road building, there should result from the meeting many valuable conclusions as to the present stage of construction and maintenance.

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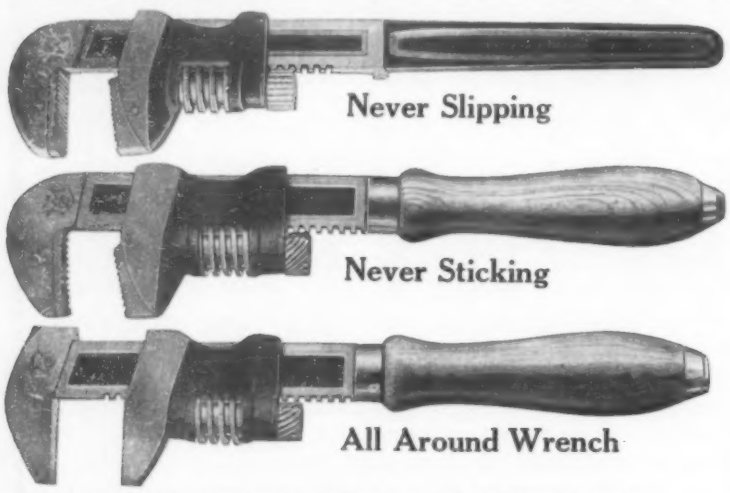

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the steam tractors lay helpless for want of water within sight of a large, modern city, was not without its effect.

The combatants became the advocates of gasoline and kerosene, respectively. From one kerosene entry in 1910, the number became eight in 1911. A year later kerosene—the cheap fuel—won the fight, just as gasoline, the labor-saver, had first won over coal. Higher engineering efficiency in the gasoline tractor could not prevail against the practical commercial odds that placed a handicap of nine cents a gallon—27 to 30 cents an acre—against laboratory skill.

With these contests decided, and both kerosene and gasoline tractors growing in reliability to the satisfaction of the customer, the five-to-one ratio of internal combustion to steam tractors for plowing now seem to make further contests unnecessary for settling the broader, general questions. The decision as to the merits of particular makes of machine is ever one that must be settled on its merits for each locality, and even each form, by itself, owing to the great variety in type and adaptability of model offered the public.

Press and public had turned their attention to the one great question remaining—the comparison of the tractor with the horse. The rules of the competition remained practically the same this year and promised no new light upon the question of the hour. The busy manufacturer and the *blasé* farmer stayed at home, and three competitors, with the usual attendance of technical representatives, had the field to themselves. These were the J. I. Case Threshing Machine Company, Racine, Wis.; Avery Company, Peoria, Ill.; and Sawyer-Massey Company, Toronto, Canada; Rumely; International Harvester; Emerson-Brantingham; Kinnard-Haines; Diamond Iron Works; Goold Shapely and Muir; Marshall; and other former contestants, dropped out and, for the most part, contented themselves with displays at the exhibition proper. As usual, many new models appeared.

From the inside, the competition was well conducted. The Canadian Industrial Exhibition, the sponsors, provided satisfactory facilities, and the conduct of the test by members of the American Society of Agricultural Engineers, acting as such, was of high order. Prof. L. W. Chase of the University of Nebraska, acted as engineer-in-charge. The judges were Prof. J. B. Davidson of Iowa State College, Prof. L. J. Smith of Manitoba Agricultural College, and Prof. H. W. Riley of Cornell University, former president of the society. Each of these gentlemen heads a department of farm engineering, and the corps of observers was composed of advanced students in agricultural engineering from the Manitoba institution, each one with the advantage of at least one year's motor contest experience. As a result, the data obtained are unusually complete and reliable, easily outranking those taken at any of the European trials which are being held with greater frequency each year.

The basis of competition was practically unchanged from that of other years, except that definite, previously announced penalties were set for definite faults. Two competitors, each having entries in the same two classes, exchanged first prize gold medals as a result of penalties, without either losing an honor, but otherwise the deductions did not affect the relative standings. The tests consisted as usual of four phases:

(*a*) A two-hour economy brake test for economy of fuel and water, steadiness of running, absence of mechanical trouble or excessive lubrication, etc.

(*b*) A half-hour maximum brake test, immediately following, to determine the highest feasible power output, i. e., without excessive consumption of supplies, vibration, heating of bearings, lubrication, or other difficulty, and without increasing the engine speed.

(*c*) A plowing test of from three to five hours, for economy, tractive efficiency, capacity (in acres per hour and power output), quality of work, and the distance traveled without replenishing supplies.

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Scientific American Supplement 1621—The Gyrostat for Ships describes the construction and application of the principle to prevent rolling of vessels.

Scientific American Supplement 1643—The Gyroscope for Balancing Aeroplanes, takes up this interesting field, which the gyroscope alone seems capable of occupying.

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(*d*) A careful comparison of design and construction by the experts mentioned.

Out of 500 points, the economy brake test was alloted 150; the maximum brake test, 50; the plowing test, 200; and the inspection test, 100. The highest net score was 437.3 points, and the lowest, 154.05 points, this last tractor suffering a total of 178.88 points in deductions from the gross. The heaviest deductions on the tractors as a class came from stops after starting tests, uneven speed, hot bearings, vibration, lack of water capacity for an 8-hour run, and failure to keep the plows in the ground throughout the tests.

The showing at the brake was quite uniformly good, developing some very close scores. Little distinction was made between the tractors on design and construction; hence the awards were settled where the average spectator likes to see them settled, i. e., upon the plowing field. The appended table, condensed from the official tables, and with bewildering extra-place decimals excluded, shows briefly the most important points of comparison, the total scores, and the relative standings. (The official tables show comparative performance or score on 178 points—a mass of figures that make better reading for the engineer than the layman.)

Only one tractor failed to win either a diploma (in a case of no competition) or a gold, silver or bronze medal. Case won seven gold medals and one silver medal; Avery, three silver medals and a bronze medal; and Sawyer-Massey, one gold medal and three silver medals. In a separate test for engine gang plows, Case won two gold medals, and Avery two silver ones.

A new feature in the observing was the use of a vibration detector, ingeniously devised from part of a steam engine indicator and the necessary linkage. While the apparatus was crude and provision for attaching it uniformly to all engines was lacking, it gave a fair basis for comparison. Penalties of from half a point to seven points were laid as a result.

The most severe criticisms on design and construction were on lubricating systems and insufficient protection of working parts from mud and dust. Tractors, especially of the internal combustion variety, have had the greatest attention paid up to date to the matters of reliability, ease of handling, and economy of fuel. Now the tendency is plainly toward a gradual refinement, both to enhance the features already mentioned and to provide for greater durability.

For the first time, the plowing tests were held in ground that had been plowed before. The furrows were deeper for agricultural reasons, and not so smooth as in the virgin sod of former years. A two-foot growth of weeds presented a new, practical problem, to which emergency, however, the plowmen were fully equal. The engine steering guide, a boon to the single-handed operator who works as tractioneer and plowman both, was not used, evidently because no one cared to risk using the extra fuel needed to push it ahead of the tractor. However, the most experienced tractioneers on the side lines held that by its use, even in such a contest, the tractioneer could have given better attention to his motor and probably more than offset the added burden by securing greater fuel efficiency.

The gas tractor men suffered in two particulars from the very advantages which have made their product such a successful competitor of the long-established steamer, viz., penalties for failure to carry an 8 hours' water supply, a point which was not even scored on the steam tractors; and labor costs, which were not added to the fuel costs in obtaining the operating expense per acre. The gas tractor, either kerosene or gasoline, saves one man, the fireman, but even without this gain the average cost per acre for steam engines was only a trifle lower than for kerosene, i. e., 46.3 cents, compared to 50.9 cents. The gasoline average was considerably higher, 62.1 cents. The plowing was not so difficult as in 1912, yet not even the best steamer cut its cost so low

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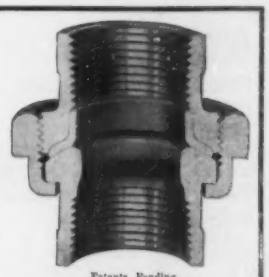

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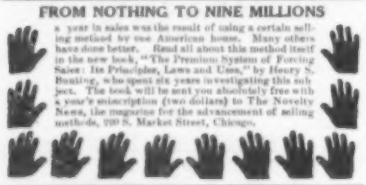

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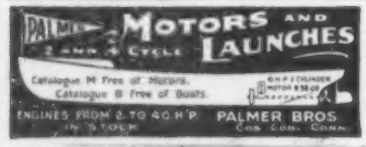

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as the best gas tractor mark of 1912 (33.7 cents, in the kerosene class).

The 5 and 6-plow tractors managed about an acre and a half of plowing to the hour, as against about an acre for the 4-plow rigs, which were practically a new element. Eight plows behind larger gas tractors seem to be good for about 2¼ acres per hour, and ten plows for 2¾ to 3 acres. Plow for plow, the steam engines showed more capacity, largely due to a higher geared speed of travel.

Revolution counters on both engines and brakes brought out the interesting variation in belt slippage of from 0.3 to 1.5 per cent. It is worth a moment's thought to calculate what this loss amounts to on belts running from about 30 to 42 miles per hour, as in these trials.

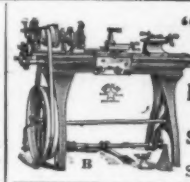
Gasoline tractors claimed first honors in mere fuel efficiency, averaging close to four times as many horse-power hours to the unit of fuel as steam tractors. Kerosene tractors this year were hardly so efficient as in 1911 and 1912, yet secured three times as much power for a given weight of fuel as the steamers. On the other hand, labor costs excluded, the steam tractors developed brake horsepower at a rough average of 20 per cent less than the kerosene engines, and every steamer beat every gasoline tractor on fuel cost per unit of power. This fact alone is a powerful factor in retaining the moderate-sized steam tractor (50 to 75 brake horse-power) wherever threshing is of greater importance than plowing.

On the whole, this year's competition was illuminating. However, manufacturers and farmers both are taking the smaller types of tractor more seriously. Some of the greatest gas engineers in the world are turning to tractor design. The public has fully accepted the tractor for the heavy, yet comparatively simple work of plowing and threshing, which these brief trials represent. Interest is now undeniably focused upon the more complicated situation on the average farm, where plowing is succeeded by disking, harrowing and seeding, hauling and harvesting where threshing is merely one of the short, big jobs for the stationary engine, and the lighter work of pumping, grinding, baling, shelling corn, etc., must be taken care of without too great a loss in mechanical efficiency.

It is a nice nut for the manufacturer to crack, this actual replacing of the horse. Many farmers are doing it, with the very types of tractor that have been shown at Winnipeg in the last few years. But the public trial, at Winnipeg or elsewhere, is a more convincing demonstration, and we venture to predict that the motor contests of the future will seek to bring out this great factor of versatility rather than minute technical differences. Certainly such a wonderful educational force as the public motor competition will not have served its purpose to either maker or buyer until the last great question is solved, and the unquestionable superiority of the general purpose tractor over the horse is demonstrated in a clear, convincing and absolutely impartial way.

Division.	Class.	Entry No.	Maker.	Cylinders. Number.	Cylinders. Diameter.	Cylinders. Stroke.	R. P. M.	H. P. Rated.	H. P. Max. Brake	Weight, Lbs.	Road Speed (Miles per Hour.) Slow.	Road Speed (Miles per Hour.) Fast.	Brake Horse-power. Economy.	Brake Horse-power. Maximum.	H. P. Hrs. per Lb. of Fuel.	Cost Fuel per H. P. Hr.	No. 14-in. Plows.
Gasoline.	A	1	Case	2	6¾	7	600	15	25	8,000	1.75	2.2	20.8	24.4	1.30	2.97	4
		19	Avery	2	6½	7	570	12	25	7,500	1.75	2.33	18.8	26.2	1.45	2.66	4
	B	2	Avery	2	7¾	8	500	20	35	12,000	2.	2.67	29.4	35.9	1.68	2.3	5
		3	Case	2	8	9	475	20	40	14,000	2.	2.9	35.7	41.8	1.71	2.26	6
	C	4	Sawyer Massey	4	6¼	8	600	25	45	17,500	2.	3.5	45.0	58.3	1.45	2.66	8
		5	Case	4	7	12	500	40	80	24,000	2.2	2.2	72.0	86.2	1.68	2.3	10
		6	Case	2	10	12	365	30	60	24,460	2.	2.	61.8	71.0	1.37	2.81	8
		7	Avery	4	7¾	8	500	40	80	20,925	1.75	2.75	61.1	73.8	1.04	3.71	10
Kerosene.	A	8	Avery	2	6½	7	570	12	25	7,500	1.75	2.33	19.1	22.9	1.05	1.9	4–3
	B	9	Avery	2	7¾	8	500	20	35	12,000	2.	2.67	27.9	32.2	1.03	1.78	4
		10	Case	2	8	9	475	20	40	14,000	2.	2.9	34.5	32.3	1.30	1.41	6–5
	C	11	Case	4	7	12	500	40	80	24,000	2.2	2.2	70.1	78.6	1.26	1.46	10
		12	Case	2	10	12	365	30	60	24,460	2.	2.	54.1	67.6	1.18	1.56	8
Steam.	A	13	Sawyer Massey	2	7¼n	10	240	27	80	31,850	.....	2.35	57.9	74.5	0.28	1.44	10
		14	Case	1	8¼	10	250	..	40	19,275	.....	2.35	39.7	57.3	0.29	1.37	6
	B	15	Case	2	9¼–13	11	250	..	80	28,530	.....	2.39	80.1	103.9	0.31	1.31	10
		16	Sawyer Massey	1	9½	11	250	25	76	34,500	.....	2.53	55.3	73.6	0.24	1.65	8
	C	17	Case	1	12	12	230	..	110	40,460	.....	2.37	110.5	135.2	0.38	1.06	14
		18	Sawyer Massey	1	12	14	230	35	115	39,000	.....	2.36	114.9	153.8	0.24	1.67	12

Division.	Make of Plow.	Drawbar Horse power developed	Acres Plowed. Total.	Acres Plowed. Per Hour	Average Drawbar Pull.	Drawbar Horse-power Hours per lb. of Fuel.	Cost fuel per acre. Cents.	Total Penalties.	Total Score.
Gasoline.	Case-Sattley	10.28	2.19	0.95	2,360	0.603	69.6	17.25	325.60
	Avery	8.52	2.12	1.01	1,770	0.568	57.4	85.5	238.95
	Avery	17.37	2.69	1.57	2,940	0.521	81.9	17.0	316.75
	Case-Sattley	18.53	3.25	1.68	3,540	0.736	57.6	13.05	352.00
	Deere	24.5	4.27	2.12	4,890	0.790	56.6	5.15	359.05
	Case-Sattley	38.79	5.12	2.73	7,350	0.915	59.9	16.25	355.55
	Case-Sattley	30.22	4.15	2.28	5,570	0.759	67.4	178.8	154.05
	Avery	37.50	5.36	3.21	6,190	0.969	46.5	45.0	290.00
Kerosene.	Avery	9.80	1.84	1.38	1,735	0.241	53.4	100.7	193.10
	Avery	15.66	2.25	1.33	2,635	0.358	60.6	62.25	238.25
	Case-Sattley	19.48	2.69	1.32	3,920	0.591	45.8	25.5	338.10
	Case-Sattley	37.65	5.36	2.81	7,100	0.562	43.8	48.2	306.15
	Case-Sattley	31.23	4.21	2.23	5,950	0.506	50.9	8.8	331.05
Steam.	Deere	50.66	5.29	3.49	7,600	0.136	42.8	27.5	382.50
	Case-Sattley	30.76	3.21	1.97	4,950	0.143	43.6	24.0	383.85
	Case-Sattley	52.75	6.59	3.38	8,150	0.167	37.4	24.0	406.70
	Deere	48.18	5.23	2.93	6,800	0.117	55.9	35.5	322.55
	Case-Sattley	74.0	9.34	4.76	11,500	0.168	37.0	19.5	437.30
	Deere	62.48	7.85	4.32	9,000	0.117	49.5	1.5	349.80



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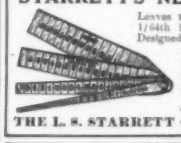

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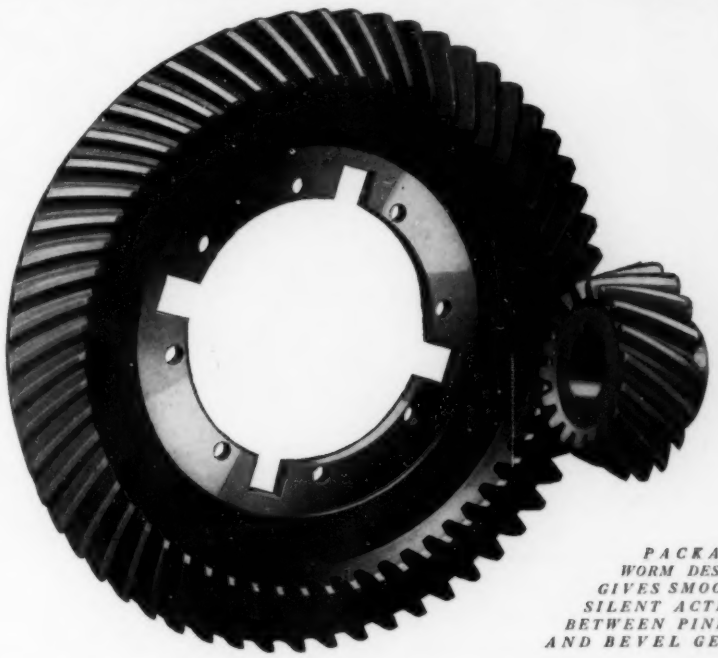

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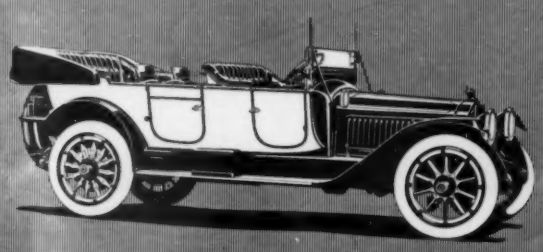

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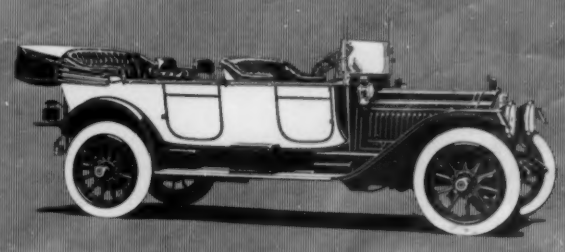

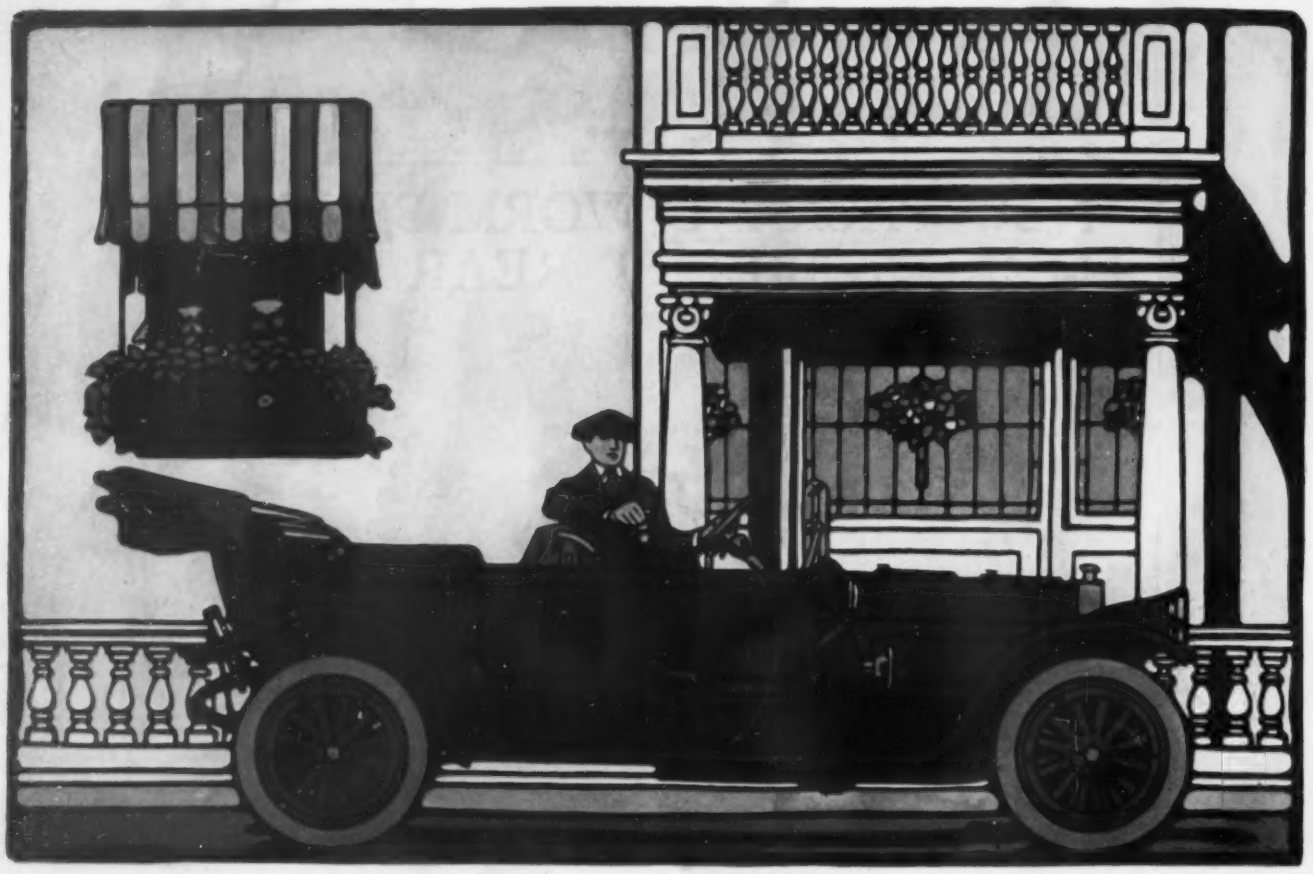

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